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NORTHWESTERN ELECTRICAL CONVENTION.

The report in other pages of the recent convention at Milwaukee of the Northwestern Electrical Association indicates that this body continues to maintain an unique position among similar ones from the high value to members of its educational feature. The great benefit it has conferred in this respect is most evident to those who have followed the proceedings of its conventions from the beginning. In the early days the most obvious proposition in electrical engineering appeared to strike most of those in attendance as novelties, but at the same time the eager desire manifested for information on managerial and technical subjects promised well for the future. At the present time we doubt if there is any other district in the United States having the same character of stations, where the latest and best practice relating to the proper conduct of lighting and power plants is more generally understood and intelligently followed than in that represented by the Northwestern Electrical Association. This can be ascribed almost entirely to the educational work of the association which, indeed, has entirely overshadowed its business objects, though the latter have by no means been neglected. Much of the credit for the results achieved is due to Secretary Mercein, whose unobtrusive guidance has kept the body clear of the pitfalls which, as experience of most similar organizations indicates, are so apt to be encountered from lack of solidarity of the interests concerned.

Of the eight papers read, those of Prof. D. C. Jackson and Mr. R. D. Mershon have a permanent value, and will later be printed at length in these pages. The paper by Prof. Shepardson on tests of incandescent lamps gives interesting data determined under practical conditions and with respect to lamps obtained under conditions similar to those applying in usual central station purchases. The lack of accordance found between rated candle-power and voltage makes it quite evident, as implied by Prof. Shepardson, that lamp manufacturers allow themselves considerable latitude in rating lamps. It also emphasizes the desirability of some central stations adopting odd voltages, and of all central stations being provided with a lamp testing outfit. The suggestion to remove lamps nearer to the source of e. m. f. when the candle-power begins to fail is one which merits attention, especially with reference to isolated lighting plants, where, indeed, in many cases the benefit of the practice has long been recognized. The paper by Mr. Frund showed the great value of a system of central station accounting which separates all the more important items entering into cost, thus enabling the manager to check the economy, by comparison or trial, of every operation having a separate account.

As at the previous convention, the subject of the utilization of the exhaust for heating purposes attracted much interest. There was quite unanimity of opinion in favor of hot-water circulation as against the direct utilization of exhaust steam for heating. Until, however, the distributing system has been in service a reasonable period and the condition of the piping then noted, any positive opinion appears premature. The proposition to place the heater for the circulation water between the engine and a condenser was viewed

with suspicion, as it well might be, for there is no margin to spare with respect to the temperature of the water even with the exhaust at the highest allowable temperature. If the exhaust heat corresponding to upper limits of temperature can be more profitably availed of in connection with a condenser, there is no room for a heating system, and vice versa. The paper by Prof. Richter dealt with merely obvious considerations so far as it related to the steam engine in itself, but brought out very clearly the advantage of the storage battery and of proper arrangement in the utilization of the mechanical power generated. In the discussion of this paper, and also in the presidential address, stress was laid upon the desirability of station managers to investigate if they are running their present equipment at the highest attainable economy, and to seek to bring it up to the highest state of efficiency rather than spend money on new apparatus which in turn may also be inefficiently operated. In view of the professed lack of engineering supervision over the plants represented in the association, this advice might be extended to cover a recommendation that the services of a competent engineer be secured to point out the directions in which ameliorations are indicated.

The paper which aroused the most interest and gave rise to the most extensive discussion was that of Mr. Fleming on alternating current series arc lighting. All of the opinion expressed was decidedly favorable to the new system of constant alternating current series lighting, which during the past year has attracted so much attention. Series alternating current lighting by incandescent lamps also developed several partisans during the discussion, and it was quite evident that one of its favorable points which appealed to the operator also a lamp buyer, is the long life of series incandescent lamps, due partly to the very constant voltage at which they are worked and partly to the sturdiness of the filament. There is no question but that residence streets may be most satisfactorily illuminated by lamps of small power, but the enclosed arc lamp of a few amperes in this case enters into competition with the incandescent lamp. That there will be a greater development of this method of illumination may be predicted, but whether the incandescent or enclosed arc lamp will be the survivor in the field remains to be determined by comparisons of cost of operation. In the discussion of Mr. Fleming's paper the same haziness of distinction between light intensity and illumination was manifested as in discussions at the recent National Electric Light convention, and, in fact, on all occasions when the subject is brought forward among central station men. We may be permitted to take advantage of this opportunity to announce that a series of articles on the subject of illumination, from the pen of an authoritative writer, will shortly be commenced in these columns. The object of the series will be not only to clearly point out the distinction between light intensity and illumination and show their physiological dependency, but also to give rational methods for determining light values and laying out schemes of illumination.

Several changes were made in the by-laws of the association which should be of benefit—unless the by-laws continue in the future to be largely ignored, as they appear to have been in the past. The election of honorary members is hedged by a method of procedure which will prevent the elevation of a "good fellow" to that distinction merely because some loyal friends put up his name at a meeting, those opposed not caring to give a negative vote for fear that it may be construed into a personal reflection on the candidate. By a change in the by-laws, it is now possible, by a letter ballot, to hold the annual meeting elsewhere than at Milwaukee. A meeting during the coming summer was provided for, which from its social features will no doubt endear still more to those in attendance the most popular of local electric light associations.

TELEPHONIC CONSOLIDATION.

The manner in which Mr. C. J. Glidden has gathered in a large part of the independent telephone interests in Michigan must arrest general attention on the whole question of telephone opposition and competition. We can testify from personal observation that the big Detroit independent exchange was a good piece of work all through, that the system was well handled, and that the company was popular. But we have always thought that its rates, like those of so many other independent exchanges, were too low for proper maintenance and for dividends; and events seem to justify such views. To what extent this wholesale defection may affect the independent cause, we can hardly say at the moment. This is a large country, the "independent" spirit is strong, and buying up is sometimes risky. There is always somebody else ready to jump in with the object of being brought out, and while the first crop of telephone independents have often been honest and sincere in their animosity toward the Bell interests, the next crop, lured by golden prospects, may be made of different stuff, persons distinctly "on the make." If there is to be competition, a fight to a finish may be the best lesson and policy, in the long run.

AUTOMOBILES AND HORSES.

No one could visit the show at Madison Square Garden this week, see the automobile exhibits, and hear the comments of the crowds, without realizing how thoroughly the public is convinced of the nearness of the change about to be made in city methods of vehicular locomotion. These new ideas are penetrating into the whole mass of the community at a rapid and encouraging rate. Those who own fine stock have already begun to recognize the fact that while the horse has never had less right than now to exist in a city full of human beings, he has as little right there for his own sake. Some time ago we stated that leading citizens of New York intended hereafter to keep their horses in the country rather than submit them to the perils of frequent tracks and crowded streets. It is now announced from Paris, that M. Menier actually intends retiring to the provinces and abandoning his beautiful hotel in that city because "it is impossible to drive a carriage and pair in safety through the streets. During last year he lost several very valuable horses through street accidents, which were not the fault of his coachman, but he could obtain no redress."

This sounds exaggerated. M. Menier is a progressive spirit. He was one of the first to take up electricity in France, and we remember noting years ago his little electric railway which ran around the dinner table delivering plats to the guests. But he is also a great breeder of horses, and is evidently one of the first to recognize that the day of the horse in the city is swiftly ending, while that of electric traction has but begun.

URBAN AND SUBURBAN GENERATORS.

To meet the conflicting requirements of congested urban and scattered suburban central-station loads with one class of generating machinery, Mr. Alton D. Adams on another page advocates again the use of double-current generators for such purpose. As yet the double-current machine has never been used for this class of work. As a rule, it is held by structural considerations to a frequency of 25 cycles per second on the alternating-current end. This frequency would be altogether too low for house-to-house transformer distribution owing to the excessive cost of small transformers for such a low periodicity. It would also be out of the question for arc lighting owing to flickering. All double-current generators which have been used in central stations up to the present supply transmission lines feeding rotary converters at the distant end, and hence a low

frequency is not only available but desirable. For railway work they are also well fitted for the same reason.

For general alternating-current distribution a central-station double-current machine should deliver 60 cycles from its collector rings. To be sure, 60-cycle rotary converters are common, but it must be remembered that they have a much higher angular speed than is common in generators. It is true that in at least two cases 60 cycles is the frequency used with double-current machines and long-distance transmission and reconversion for railway purposes, but the generators in these cases are belted. It is difficult to see how under existing conditions of engine speed a direct-connected 60-cycle double-current machine could be built. Look where one will from 50 to 5000-hp sizes, and it will be found that direct-connected 60-cycle alternators force the engine speed up to maximum allowable limits and force the armature diameter out until economy of material is considerably sacrificed, and even then the poles are crowded for an alternator and squeezed beyond all reason for a direct-current machine. It is needless to state that where such a refinement as double-current working is desired belts would be out of the question. Under existing conditions about the only cases where direct-coupled double-current 60-cycle machines could be used are hydraulic plants with high heads using wheels with high rotational speeds. A probable new factor in steam electrical work which would make 60-cycle double-current machines easy of construction is the steam turbine. Large direct-coupled alternators now building have four poles and run at 1800 r. p. m., giving 60 cycles. The angular speed is so high that a great peripheral speed is obtained with the most desirable ratio of armature diameter to length. This high peripheral speed gives room between pole centres even at 60 cycles for the many slots and teeth necessary for direct-current work.

THE DESIGN OF MONOPHASE AND POLYPHASE GENERATORS.

The article by Mr. Behrend, of which the second section appears in this issue, deals with a subject of considerable practical importance. Each year that passes develops larger electrical units of alternating-current dynamo construction, partly because of the economy of first cost, reckoned per kilowatt of output, and partly on account of the reduced cost of maintenance and superintendence, estimated upon the same basis. The large output of these machines is limited very frequently by their regulation, rather than by their heating. In other words, the difficulties in the design of large alternators are greater in the direction of making a machine that will keep cool. Consequently, every advance that is made in the knowledge of the factors that enter into the problem of regulation is a gain to the engineering community. The article gives some experimental results which are valuable, not only as examples of the theory discussed, but also as giving results upon which to make comparisons with machines of American design. The term short-circuit characteristic is employed with a significance that seems to be new. It is the characterisitic curve giving the armature current strength in amperes with relation to the field excitation in amperes, the armature being short-circuited through a single ammeter, if a monophase machine, and through an ammeter in each armature circuit if a polyphase machine.

With the aid of the observed open-circuit characteristic curve, and the short-circuit characteristic curve of an alternator, it is pointed out that the drop of pressure can be approximately computed for wattless currents on actual load. This is practically the same method that is generally employed in the United States. From the observed short-circuit and open-circuit characteristics, the apparent internal impedance of the armature is usually determined by the ratio of the values on each curve at any given excitation. If the magnetic circuit of the machine remained practically unsaturated, or at constant reluctance at all excitations, the apparent impedance of the armature obtained in this way should be constant. Owing, however, to the approach to saturation of the magnetic circuit under increasing saturation, the apparent impedance of the armature is not quite constant but diminishes with the excitation, and for reliable results the apparent impedance should be taken for the particular excitation given to the generator. The impedance of the generator is practically all reactance from a numerical point of view, because the reactance is always so much greater than the ohmic resistance; and, as is virtually pointed out in the article, we may often neglect the ohmic resistance of an armature in dealing with the question of computed regulation, without making any sensible error. Steinmetz has shown that the armature reaction and leakage reaction of an alternator act in essentially the same manner upon the electromotive force as does the self-induçtance, and that the apparent reactance, or apparent impedance, is a virtual reactance or impedance due to the joint effect of the real self-inductance of the armature and the armature reaction.

The conception of apparent reactance obtained in this way is most useful in dealing with alternating-current generators. We have only to multiply the vector apparent impedance by the vector current delivered at terminals to obtain the vector drop of pressure in the armature which, subtracted vectorially from the internal e. m. f. at the observed excitation, will give the terminal pressure. The numerical difference between the internal and terminal e. m. f. gives the apparent drop of pressure. This is the quantity which is so important to the station manager. If the power factor of the station load becomes reduced by the presence of an inductive load on the system, the effect is to vary not the magnitude but the phase of the vector armature drop, and introduce an unduly large apparent armature drop or unduly bad regulation. It would seem that the apparent armature reactance of the alternating-current generator is at least of as great importance as its ohmic resistance, and it would be desirable to have this quantity clearly formulated for each machine in its regular data, either under the title of armature apparent reactance, or expressed as an apparent reactance factor in terms of the ohmic resistance. When the armature resistance and reactance are stated, the drop of pressure under any given conditions can be quickly computed or approximately predetermined. But unless the armature reactance or equivalent data are forthcoming, a station manager may be kept entirely ignorant of the regulation of an alternator until the load is actually put on. It sometimes happens that the maximum excitation will not suffice to bring the machine up to full pressure under an inductive load.

Equivalent information to the apparent reactance, or apparent impedance, of an alternator is conveyed by the short-circuit characteristic of the short-circuiting current strength at full excitation. The latter is usually in the neighborhood of three times the full-load current strength but varies within wide limits. In the case of a direct-current generator, compound-wound, as for example in street railway systems, if a short-circuit occurs on the system, the generators are ready to respond indefinitely to the demand for current, and if the circuit breakers failed to protect them the steam engines would become stalled and, perhaps, strained by the unduly heavy load. In the case of an alternating-current generator, however, the effect of a short-circuit cannot be nearly so severe, because in the first place the maximum current on short-circuit is not more than a few times the full-load current strength, and also because the power required to drive the machine under short-circuit is very small relatively to the power required at full load. But although this immunity from very heavy overloads by short circuits, enables circuit breakers to be dispensed with on most alternating-current circuits, yet a heavy penalty is paid for the advantage in the amount of iron and copper that must be used in an alternator in order to maintain given regulation at full load with a lagging load-current.

The Cuban Cable Dispute.

The following claims and arguments have been formulated before the Insular Committee of the House of Representatives by Mr. W. W. Cook, counsel for the Commercial Cable Company, in favor of the bill granting it the right to land a cable in Cuba:

"First—The Commercial Cable Company, of Cuba, claims that the grant to the Western Union Company was obtained by false and fraudulent representations, which appear on the face of the grant itself.

"Second—We claim that the grant expired in 1880.

"Third—We claim that the grant was not an exclusive one.

"Fourth—We deny that there was any legal condonation of the fraud or any confirmation of the grant, or that there was any consideration for the same, or that condonation applies to a public grant like this.

"Fifth—We deny that this alleged monopoly is a property right protected by the treaty of peace.

"Sixth—We claim that neither Cuba nor the United States is bound by a Spanish monopoly of cable business to the United States, and that the rules of public policy as laid down by President Grant relative to cable monopolies apply to this Cuban cable.

"Seventh—We claim that this country, as trustee for Cuba, and as de facto sovereign, should put an end to this monopoly, as it put an end to the slaughter house monopoly and the Spanish bank monopoly.

"Eighth—We are willing that any permit to us shall be subject to modification or repeal at any time by this government or any future government of Cuba."

British Telegraphers at the Front in Africa.

The British Government Post-Telegraph departments have already contributed to the army in South Africa nearly 500 men, of whom more than 200 were skilled telegraph operators, who could be ill spared from the already undermanned service. Reports to the War Office state that the telegraphers are rendering splendid service. It is said that the use of the Wheatstone automatic system on the field of battle is the first in the history of warfare. Moreover, it was worked duplexed, which at the outset was prophesied to be impossible under the rough circumstances of campaigning. At the Modder River the telegraphers were under fire for a whole day. Then they worked through the night on official and press messages. Later, despite the rules limiting the number of correspondents and the length of a message each man can send, the operators sent 100,000 words. The total after the Magersfontein battle was much greater, but the operators got it through without a hitch at the high average speed of about 200 words per minute.

A majority of the telegraphers are volunteers—members of the Twenty-fourth Middlesex "Post Office Rifles." When it was known that the Twenty-fourth would be wanted to supply a considerable number of telegraphers as Signal Corps men, the *Telegraph Chronicle*, the organ of the operators, made a stirring appeal to the men and described in glowing terms the gallantry of American telegraphers in Cuba, Puerto Rico and the Philippines, and told how, at the conclusion of the Spanish-American war, an army order was issued thanking them for their work.

"It is our men's ambition," says the Superintendent of Telegraphs, "to do as good work as the American telegraphers did for their country in Cuba."

Telephone Consolidation in Michigan.

A despatch from Detroit, Mich., states that the Erie Telephone Company has closed a deal whereby the Detroit Telephone Company and the Independent State Telephone Company become consolidated with the Michigan Bell Company. The companies merged into the Bell Company have 6000 miles of independent long-distance lines, and control 10,000 subscribers in forty-six cities of Michigan. The deal was negotiated by President C. J. Glidden, of the Erie Company. Charles Flowers was elected president of the two companies absorbed, and James Thorpe, of Lowell, Mass., was made secretary and treasurer.

The terms under which the Erie Telephone people secure control of the Michigan independent companies call for the purchase by the Erie syndicate of $500,000 of the stock of the Detroit Company at 50 cents on the dollar, and the entire issue of bonds at 85 cents on the dollar. The bonds aggregate $600,000. The purchase of the Independent State line stock was at the rate of 50 cents on the dollar for $600,000 of stock and 85 cents on $100,000.

Hon. James M. Thomas, of Chillicothe, O., president of the Independent Telephone Association of the United States, and chairman of the Interstate Traffic Association, which is formulating a plan of operating the independent long distance toll line companies, was in Cleveland last Saturday. In speaking of the reported sale of the controlling interest in the Detroit Telephone Company to the Erie Telephone Company, Judge Thomas said that he understood that the majority of the stock of the Detroit Telephone Company and the new State Line Company had been sold to persons interested in the Erie Telephone Company. He said this was not a surprise to the independent telephone people, as those who were in touch with the movement were aware that for more than a year negotiations were pending between the companies and it had been understood by those in a position to know that a sale would be finally consummated.

When asked what effect the sale would have upon the growth of the independent interests, he replied that he thought it would amount to nothing, as these organizations had never been in close touch with the other independent telephone interests of the country. The properties owned by the Detorit Telephone Company and the New State Telephone Company, he said, would not amount to more than 25 per cent. of the entire independent systems in Michigan. He stated that there are large and successful independent systems in Grand Rapids, Saginaw, Kalamazoo and Lansing, which are connected with the lines of the United States Company.

The Submarine Boat Situation.

Although the electric submarine boat Holland responded most admirably and successfully to all the special requirements exacted from her by the naval authorities, with the tacit, or even expressed understanding that as a result the purchase of several such boats would be recommended, the Naval Board of Construction has just submitted an adverse report. This action was taken after the Board had, it is said, considered the favorable reports on the boat made by the Naval Board on Inspection and Survey and Chief Engineer John Lowe, and had made a personal inspection of the Holland at the Washington Navy Yard. Chief Engineer Lowe recommended the construction of a large number to be stationed at New York. Rear Admiral Hichborn voted for the purchase of the Holland, on the ground that the experimental stage had been passed and the addition of such a vessel to the naval service was desirable.

The Board's action will go to the department for approval, and it is expected an effort will be made to secure the appointment of a new Board, whose decision will be final. Those interested in the boat find it difficult to explain adverse action after they have gone to great expense and met every condition exacted in the trials.

A special despatch from Paris of January 20 says: The government naval proposals involve an expenditure of 750,000,000 francs, of which 500,000,000 francs is to be devoted to the reorganization of the fleet. M. Delaporte, Republican Radical Deputy for Deux-Sevres, who reported on the scheme, has just declared himself favorable to the majority plan. His report contains some remarks regarding the proposed submarine boats, especially in connection with recent experiments in the United States with the submarine torpedo boat Holland. He asserts that the new type of submarine vessel, of which the government proposes to build two, will have a sphere of action on the surface of the water of from two hundred to four hundred knots, and a submarine sphere of action of from forty to forty-five knots. Thus, he says, these vessels will be of offensive value, instead of merely a defensive type. He expresses the hope that France will provide herself with a large number of these submarine war vessels.

Another Paris despatch says: The report upon the naval budget has just been distributed among the Deputies. It devotes considerable attention to the submarine torpedo boats, which it strongly advocates as a powerful arm of war and a necessary adjunct to the existing or future naval forces of France. It appears that the type most favored by experts—namely, that of M. Gustave Zédé—is anything but perfect. Notwithstanding the increase of speed which has been secured, M. Zédé cannot hope to overtake an enemy, and can only attack him by surprise. The boat's range of action is limited to 138 miles at the most. In the case of the Morse the range of action is even less, for, despite its increased tonnage, the latter type can only operate in a distance of 120 miles.

The Factors Which Determine the Design of Mono-Phase and Polyphase Generators.—II.

BY B. A. BEHREND.

THE DYNAMIC CHARACTERISTIC OF THE ALTERNATOR.

THE preceding article dealt with the determination of the static characteristic of the alternator, and with the influence of the pole-pitch.

That the determination of the dynamic characteristic of alternators is bound up with far greater difficulties than are met with in the determination of the static characteristic, need not be told to the designer of alternating-current machinery. Indeed, it is not very long ago that the obstacles in the way of the designer seemed almost insurmountable. To-day it must seem almost ludicrous to those who have taken active part in the evolution of alternating-current machinery and who have eventually arrived at clear ideas, that the form of the wave of the e. m. f. was invariably made the scapegoat for mistakes in the design.

A great step toward the solution of these problems was taken, when the short-circuit characteristic of the alternator was made use of, if I mistake not, first in 1895 by Dr. Behn-Eschenburg.[1] From the theoretical standpoint, his method could hardly be considered satisfactory; a great many objections might be justly urged against his theory. But as a method for determining the drop it has proved very valuable. Dr. Behn-Eschenburg had arrived at his result by treating the alternator like a transformer, in which case the method is correct. Everybody is to-day familiar with Mr. Kapp's admirable way of determining the drop of voltage in transformers.[2] The simplicity of his method, the ease with which it explains phenomena so complex as the so-called "Ferranti effect," would make it most valuable to the designer of alternators, if it were applicable to these machines. The present author has contended for the past three years that we are justified in applying this method, in spite of its theoretical inaccuracy, to the calculation of alternators if we are only mindful of the assumptions on which the method is based.[3] The following series of experiments will justify this position.

It is well known that the maximum drop occurs in alternating current apparatus when the current lags behind the e. m. f. by one-quarter of a phase. Furthermore it can easily be shown that for a power factor below 0.60 the drop is practically equal to the drop caused by a wattless current. In our investigation we shall therefore study the influence of wattless currents on the drop. A large drop is, of course, the most favorable for the verification of the theory. A small drop, as caused by currents in phase, or nearly in phase, with the e. m. f., is not suited for rendering a decision as to whether a theory which lays claim to the determination of the drop is correct or not. The use of wattless currents for the determination of the drop has the further advantage that the drop caused by the ohmic resistance of the armature may be neglected without any inaccuracy worth mentioning.

In order to determine the dynamic characteristic from the static and short-circuit characteristics, which we assume to be known or predetermined (how this can be done will be shown in the third section of this article), we can proceed in the following manner:

If we assume that the armature reaction and armature leakage within the alternator have the same effect as an induction coil placed outside the machine, then the e. m. f. which is to overcome the reactance of this coil must be in quadrature with the current; and as we take from the generator a wattless current, the e. m. f. of self-induction is in an exactly opposite phase to the impressed e. m. f. of the generator. Hence, in order to get a point of the dynamic characteristic, we should simply have to deduct the e. m. f. consumed in the induction coil, from the impressed e. m. f. of the alternator. If we take an ordinate of the static characteristic, and divide it by the short-circuit current belonging to the same excitation, we immediately get the reactance of the induction coil; or, as we assumed this reactance to be equal to the combined effect of armature reaction and armature leakage, this quotient gives us the *apparent* reactance of the armature. I say *apparent* reactance, as the real reactance may have a different value.[4]

Let us now see whether this method yields results in conformity with fact and observation.

[1] *L'Industrie Electrique*, Paris, Aug. 25, 1895.
[2] Transformers for Single and Multiphase Currents. By Gisbert Kapp.

In Fig. 3 the Curve I. is the static characteristic of a 500-hp three-phase inductor-generator for 2000 volts between the lines. The speed is 406 r. p. m., the frequency 54. Curve II. represents the short-circuit characteristic. The generator was working on induction motors running light; the current was therefore practically in quadrature with the voltage at the terminals. The points marked represent an inductive load of 96 amperes. This current could not be taken out at voltages below 2000 volts, as the magnetizing current of the motors decreases with the lower voltage. It has therefore been necessary, in order to construct a curve for constant current, to make allowance for this difference. As the drop may, for low saturations, be set proportional to the current by which it is caused, the drop as represented by the points of Curve III. is obtained by multiplying the observed drop by the ratio 96 ÷ observed current. The broken line, Curve III., represents the drop calculated in the following manner:

For 62 amperes excitation the generator produces on open-circuit 2760 volts. The short-circuit current is 920 amperes. The apparent reactance of the generator for this excitation is given by the ratio 2760 ÷ 920 equal to 3.00. Hence, the inductive drop for a current of 96 amperes is equal to $5 \times 96 = 288$ volts. This deducted from 2760 volts gives 2472 volts at the terminals.

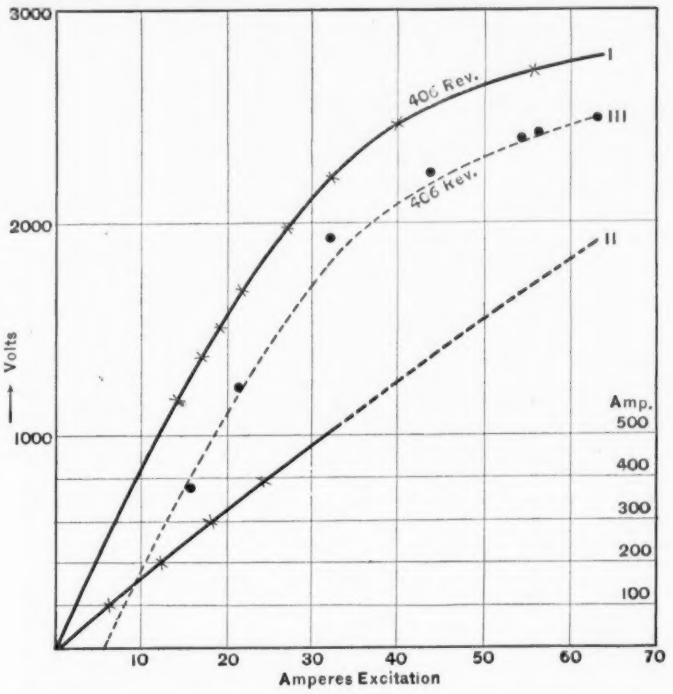


FIG. 3.—CHARACTERISTICS OF THREE-PHASE INDUCTOR GENERATOR.

Table I. is calculated in this manner. The first column contains the exciting current *i*. The second column, marked I., contains the volts on open circuit, interpolated from Curve I., in Fig. 3. The third column, marked II., contains the values of the short-circuit current, also interpolated from Fig. 3. The fourth column, marked Et, represents the volts at the terminals of the generator when working on the inductive load of 96 amperes. The fifth column, marked III., represents the calculated values of the terminal volts, as represented by Curve III., in Fig. 3.

With the exception of the fifth series of observations, the agreement of calculation and experiment may fairly be called perfect. I am inclined to think that the disagreement in this one case is due to an inaccuracy in the measurement of either the voltage or the speed.

[3] See the author's contributions on this subject in the *Elektrotechnische Zeitschrift*, Berlin, 1896, pp. 715, 771; 1899, p. 837.
[4] Mr. C. P. Steinmetz, in his admirable work, "Alternating Current Phenomena," 1st edition, p. 238, introduces for the combined effect of armature reaction and armature self-inductance (this term is here open to criticism, as the inductance is caused by the leakage lines of the armature current), the name synchronous reactance. The apparent reactance need not be equal to the synchronous reactance, though this is generally the case. We must bear in mind that the apparent reactance is a calculated value; hence, these two quantities will be equal only if the method employed is correct.
If we attempt to use the apparent reactance in the vector diagram for the determination of the power consumed by the circuit on which the generator works, we may be led into serious blunders. See for such an attempt Dr. Behn-Eschenburg, *L'Industrie Electrique*, Aug. 25, 1895.
The e. m. f. in the vector diagram is considerably greater than the real e. m. f. within the generator, on account of the armature reaction; besides, it is very doubtful whether we may rely on this method for power factors near unity. In this case, the relative position of the armature with respect to the field is different from that at short-circuit, causing an increased self- inductance of the armature. If the iron in the armature between the slots is highly saturated, the distortion of the field, caused by the armature currents, will produce an additional drop just as in direct current machines.

To enable the reader to judge for himself as to the correctness of the method here employed, other series of tests may be adduced.

The Curves I. and II. in Fig. 4 represent the static and short-circuit characteristics of a three-phase inductor-generator for 175-hp, 5200 volts, 500 r. p. m. and 50 p. p. s. Table II. contains side by side

TABLE I.

i	I.	II.	E_t.	III.
62	2760	920	2470	2472
56	2710	840	2410	2400
54	2690	815	2390	2373
44	2550	680	2230	2190
32	2220	510	1900	1802
31	1650	340	1230	1184
15.5	1270	255	747	792

the results of the tests and the calculated values of the voltage at the terminals. The symbols at the heads of the columns are the same that were used in the preceding table. The load of the generator consisted of wattless current. This current is given in the sixth column of the table.

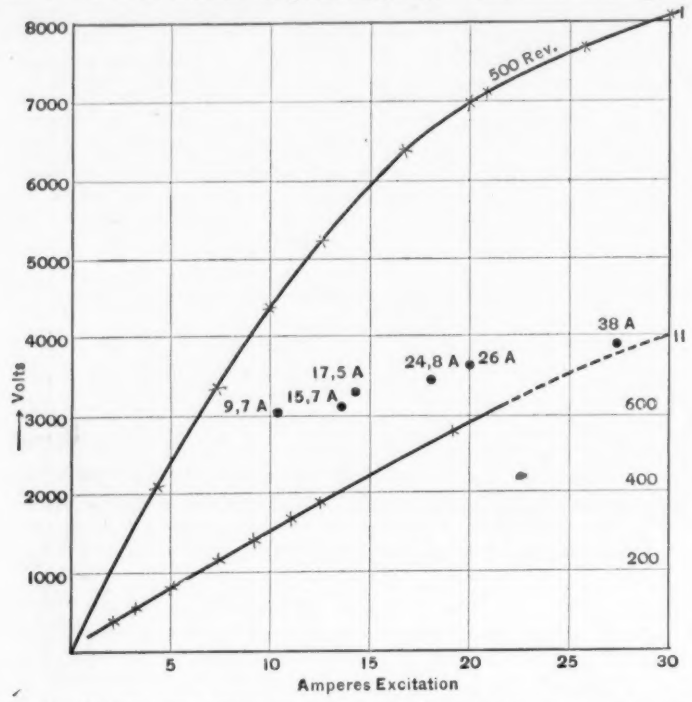


FIG. 4.—STATIC AND SHORT-CIRCUIT CHARACTERISTICS OF THREE-PHASE INDUCTOR GENERATOR.

TABLE II.

i.	I.	II	E_t.	III.	Load amperes
10.7	4600	32	3030	3200	9.7
13.7	5600	41	3120	3460	15.7
14.5	5850	43	3290	3470	17.5
18	6650	53	3470	3540	24.8
20	7000	58	3640	3860	26
27.5	7830	75	3910	3870	38

The agreement is again good, especially if we take into consideration the difficulties connected with the measurement of such high voltages.[8]

Fig. 5 represents the characteristic of a 450-hp, three-phase current generator of the inductor type. Number of r. p. m. 600, frequency 60, voltage 6700 between the lines. Pole-pitch 33 cm. The generator was loaded with a synchronous motor and the following data were observed:

Generator.—530 r. p. m., 6000 volts, 30 amperes, 34.5 amperes excitation. To this excitation correspond 97 amperes short-circuit current and 9830 volts on open circuit at 600 r. p. m.

Synchronous Motor.—Excitation of the synchronous motor 11.8 amperes. The synchronous motor as a generator developed with this excitation 55 amperes on short-circuit and 3900 volts on open-circuit.

With these data we find: First, the terminal voltage of the generator ought to be, if the 30 amperes are wattless current, $9830 - 30/97 \times 9830 = 6760$ volts at 600 r. p. m. If we reduce this to 530 r. p. m. we get $530/600 \times 6760 = 5970$ volts, instead of 6000 volts as observed. Secondly, if we start our calculation from the synchronous motor, the terminal voltage ought to be $3900 + 30/55 \times 3900 = 6030$ volts.

The three tests described above were made on inductor generators. The following data are from a very comprehensive series of observations on a generator with alternating poles.

Two dynamos with four external poles and revolving armature in star connection were used for the tests. One machine was run as a generator, the other as a synchronous motor. The pole-pitch was 77 cm., the air-gap 1.3 cm. The ratio of width of pole to pitch of pole was 0.60. In a design like this the leakage is naturally very small. This is manifested by the low value of the ratio of the ampere turns in the field to the ampere turns in the armature, which ratio was 2.30. The number of r. p. m. was 470, the frequency 15.7 p. p. s. The voltage of this machine was 180 volts, the current in each phase 650 amperes, corresponding to an output of 200 k. v. a. The following table and Fig. 6 contain the results of the observations:

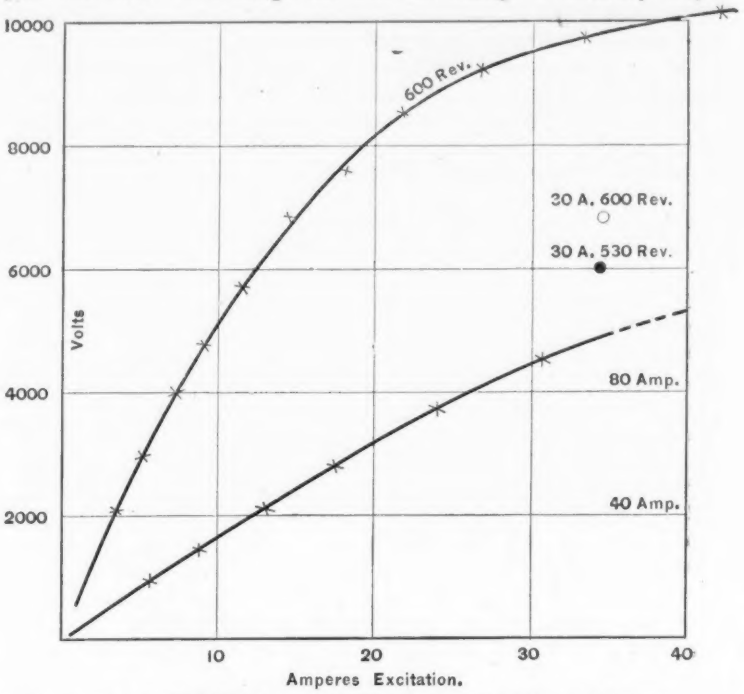


FIG. 5.—CHARACTERISTICS OF THREE-PHASE INDUCTOR GENERATOR.

TABLE III.

GENERATOR.				MOTOR.				
Amperes excitation.	Terminal volts observed for 655 amperes Curve III.	E. M. F. interpoted Curve I.	Amperes short-circuit interpolated Curve III.	Terminal volts. Calculated.	Amperes excitation.	E. M. F. volts Curve IV.	Amperes short-circuit for excitation corresponding to terminal volts.	E. M. F. of m tor. Calculated.
18.5	86	147	1430	79.6	0	0	750	19
20.0	94	154	1550	89	0.8	9	830	20
23.5	118	171	1830	109.8	3.8	35	1100	47 7
28.5	142	188	2200	132	7.5	69	1400	75.6
32	158	198	2500	146.1	9.7	88	1630	94.5
37.5	176	208	2920	161.3	14.0	119	1940	116.5
45	192	221	3500	179.7	20.3	157	2370	139

The current between generator and motor was 655 amperes. Generator and motor being exactly alike, the much smaller excitation of the synchronous motor and the large current flowing between the two machines insured a power factor which did at all events not exceed 0.20. The terminal voltage of the generator is calculated as in the preceding examples. The e. m. f. of the motor is computed from the terminal voltage and the short-circuit current belonging to an

[8] In the *Elektrotechnische Zeitschrift*, Berlin, Sept. 14, 1899, Herr A. Rothert advocates an old method for the determination of the voltage at the terminals. He says of this method that it "has won for itself many adherents." According to this method, we have to deduct the ampere-turns of the armature from the ampere-turns of the field if current and e. m. f. are in quadrature. In our case, for instance, a current of 38 amperes tends to demagnetize the field, according to the short-circuit curve II., with a power equivalent to 12.7 amperes. This is to be deducted from 27.5 amperes, the excitation at 38 amperes load. The resultant magnetizing force is, therefore, 14.8 amperes, which corresponds to a voltage of 5900 volts, instead of 5900 volts, as observed!

excitation which corresponds, not to the e. m. f., but to the terminal volts; that is to say, to that excitation of the machine which is necessary to produce the terminal voltage on open circuit.

The agreement of calculation and observation is by no means so perfect in this case as in the foregoing examples. This difference is due, without doubt, to the considerably smaller leakage of these large four-pole dynamos. The armature winding was distributed over the surface of the armature in 216 open slots, thus greatly diminishing the self-inductance of the armature. The pole-pitch of 77 cm. is much larger than usual, thus in its turn diminishing the leakage.

Curve I., Fig. 6, represents the static characteristic, equal in generator and motor. Curve II. is the short-circuit characteristic, also equal in the two machines. Curve III. is the dynamic characteristic for 655 amperes wattless current. Curve IV. is the e. m. f. of the synchronous motor, taken from its static characteristic by means of the values of the observed exciting current. This curve demonstrates that the current must have been practically in quadrature with the e. m. fs. and the terminal voltage. The broken line curve below Curve III. represents the values of the terminal voltage, calculated according to the method employed in this paper. The broken line curve above Curve III. represents the terminal voltage calculated by

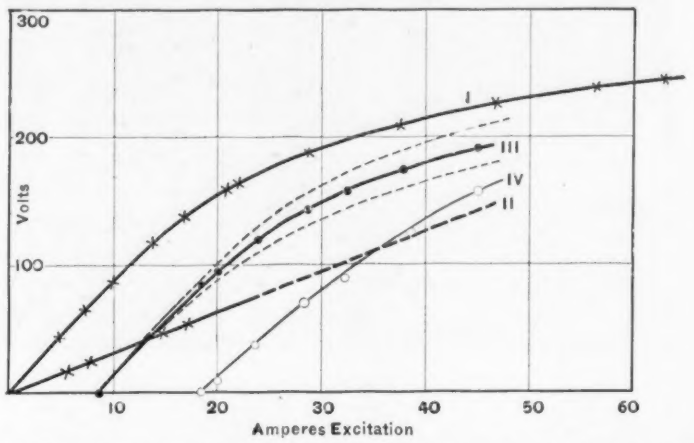


FIG. 6.—CURVES RELATING TO TEST OF GENERATOR WITH ALTERNATING POLES.

simply deducting the armature ampere-turns from the field ampere-turns.

This case is very instructive. First, it shows that neither method is theoretically correct. Secondly, it teaches us that the method which has been employed all through this paper, may give values of the terminal voltage lower than those observed. Though this is certainly no advantage of the method, neither from the standpoint of the theorist nor from that of the designing engineer, yet it will be a "safe" method. The designer who is conversant with these facts knows beforehand that the terminal voltage, as determined in this manner, will surely be the lowest possible value. Some experience will soon teach him in what cases he may expect a drop approaching the calculated one, and in what cases the drop is likely to be smaller than he expected. The difference between the calculated and the observed values of the terminal voltage does not exceed, even in this case, 8.4 per cent. of the actual value. If, on the other hand, the designer relied on the method of the addition or subtraction of the ampere-turns of the armature and the field—treating them, of course, as vectors—he would attain results which might induce him to proportion insufficiently the magnetic circuit and the field coils.

It would be useless to here multiply the examples, as every electrical engineer can convince himself of the correctness, within wide limits, of this method.

As the drop is due to the combined effect of, first, the leakage of the field; secondly, the reaction of the armature; and, thirdly, the leakage of the armature, a satisfactory theory must account for each of these factors. Our method of determining the combined effect of these three factors from the short-circuit curve and the static characteristic does not do this; it can therefore not properly be called a theory. If, indeed, it were possible to design a generator without field leakage, and without armature leakage, the method here adopted would give unsatisfactory results. But, at present, the best alternators have considerable strayfields, large enough to justify the application of the method here advocated for practical purposes.

Space does not permit me to discuss in detail the influence of the three factors mentioned above; viewed from the practical standpoint the question turns mainly on the avoidance of leakage. Now the leakage in the field as well as in the armature can be diminished considerably by enlarging the pole-pitch; that is to say, by placing the poles apart as far as is compatible with an economical design. We shall dwell on this point in the third part of this article.

From the foregoing the reader will have gained the impression that, if it were possible to predetermine the short-circuit characteristic of an alternator in such a manner as to take all important factors into account, we should have at our disposal a simple method which would enable us to calculate the dimensions of alternators with an exactness which would more than suffice for all practical purposes. I shall show in the following section how this may be done.

The "Central Energy," Multiple Switchboard Independent Telephone Exchange, Parkersburg, W. Va.

ONE of the most modern and complete systems in the telephone field has recently been installed by the West Virginia Western Telephone Company in their exchange at Parkersburg, W. Va. The company is one of the strongest in the independent field, having a large number of exchanges and a network of toll lines throughout Western West Virginia, having connections with several thousand miles of line.

The plant was started under the most adverse circumstances, several previous attempts to install an exchange having proved unsuccessful, owing to the strong opposition by the old company.

The West Virginia Western Company, however, had among their

FIG. 1.—POLE-LINE CONSTRUCTION.

many stockholders and officers such men as J. H. Grogg, of West Union; C. E. Haddox, Petroleum; Levin Smith, Parkersburg; R. H. Rutherford, Cairo; J. H. Lininger, Harrisville, W. Va., who represent millions of capital, and when the franchise was secured the company immediately began the construction of the plant, with practically no subscribers' contracts in hand. No expense was spared in the construction of the exchange, with only the very best material obtainable. The outside construction is copper metallic throughout, using a large amount of John A. Roebling's Sons Company's cable. The work is done in substantial manner.

The apparatus adopted is the "Central Energy" system and the multiple switchboard of the Stromberg-Carlson Telephone Manufacturing Company, of Chicago. While the "central energy" system has been in use in many exchanges for a number of years, the Parkersburg plant is one of the first in the independent field to be equipped with a strictly multiple switchboard in connection with this method, and its entire success is of general interest.

The switchboard, shown in Fig. 4, is built with a capacity for 1800 subscribers, and fully equipped for 500 lines. On the multiple board,

each operator is within reach of any subscriber's line in the entire exchange, enabling any one operator to complete the connections with any call received, and avoiding the usual delay of transferring the call from one operator to another to have the connection completed.

When a call is made on this board a visual signal at the top of the board plate indicates the number calling. These signals are of the regular tubular drop pattern and are very durably constructed. When a signal has indicated, the operator inserts a plug in the corresponding number answering jack, these jacks being placed at the bottom of the board plate. On inserting the plug the line signal is automatically restored. Throwing the key in the listening position cuts the operator's set into the circuit, whereupon the number desired is

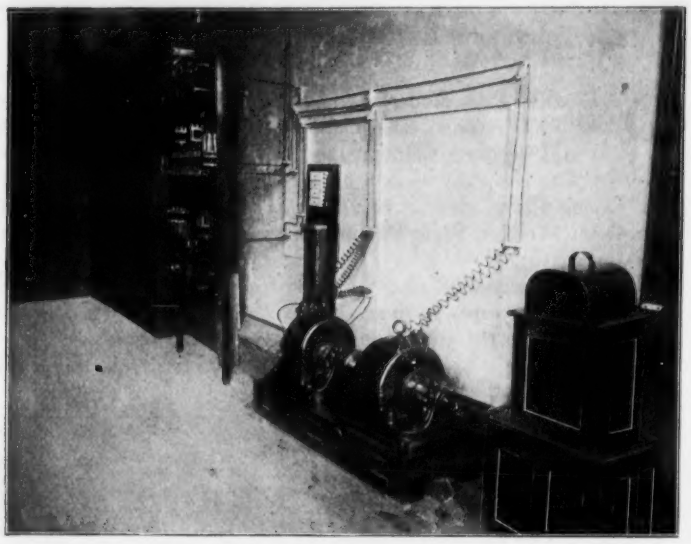


FIG. 2.—GENERATING PLANT.

obtained. The operator then places the tip of the mate plug in the multiple jack of the number wanted, and if that line is connected with another subscriber on any one of the other sections, a "click" is given in the operator's receiver, indicating that the party wanted is "busy," and the calling party is immediately notified of the fact.

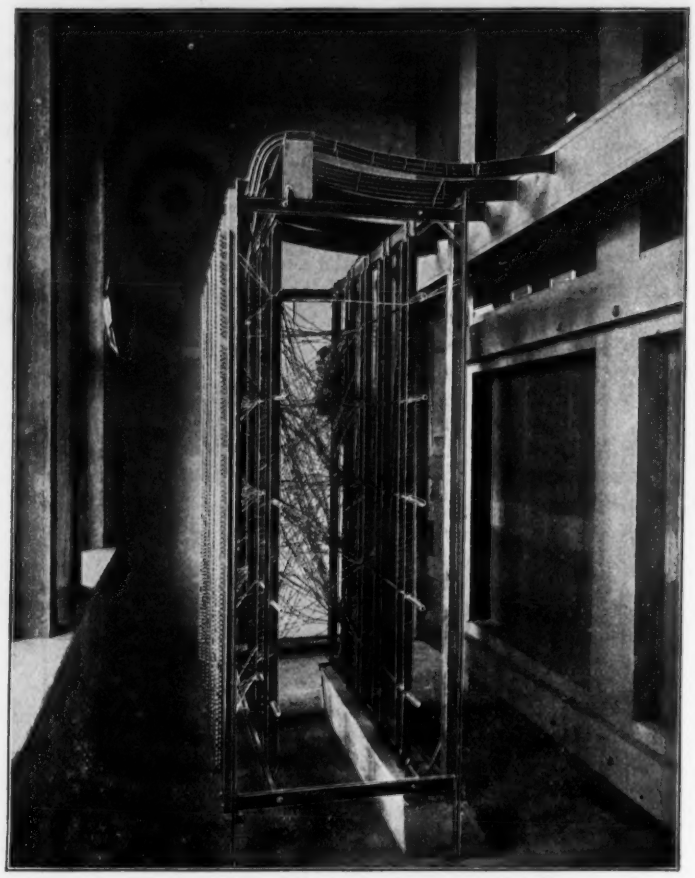


FIG. 3.—MAIN DISTRIBUTING BOARD.

If no "click" is received, the plug is inserted and the key is pressed to throw in the power generator and the party called. When both subscribers replace their receivers, a visual signal on the cord

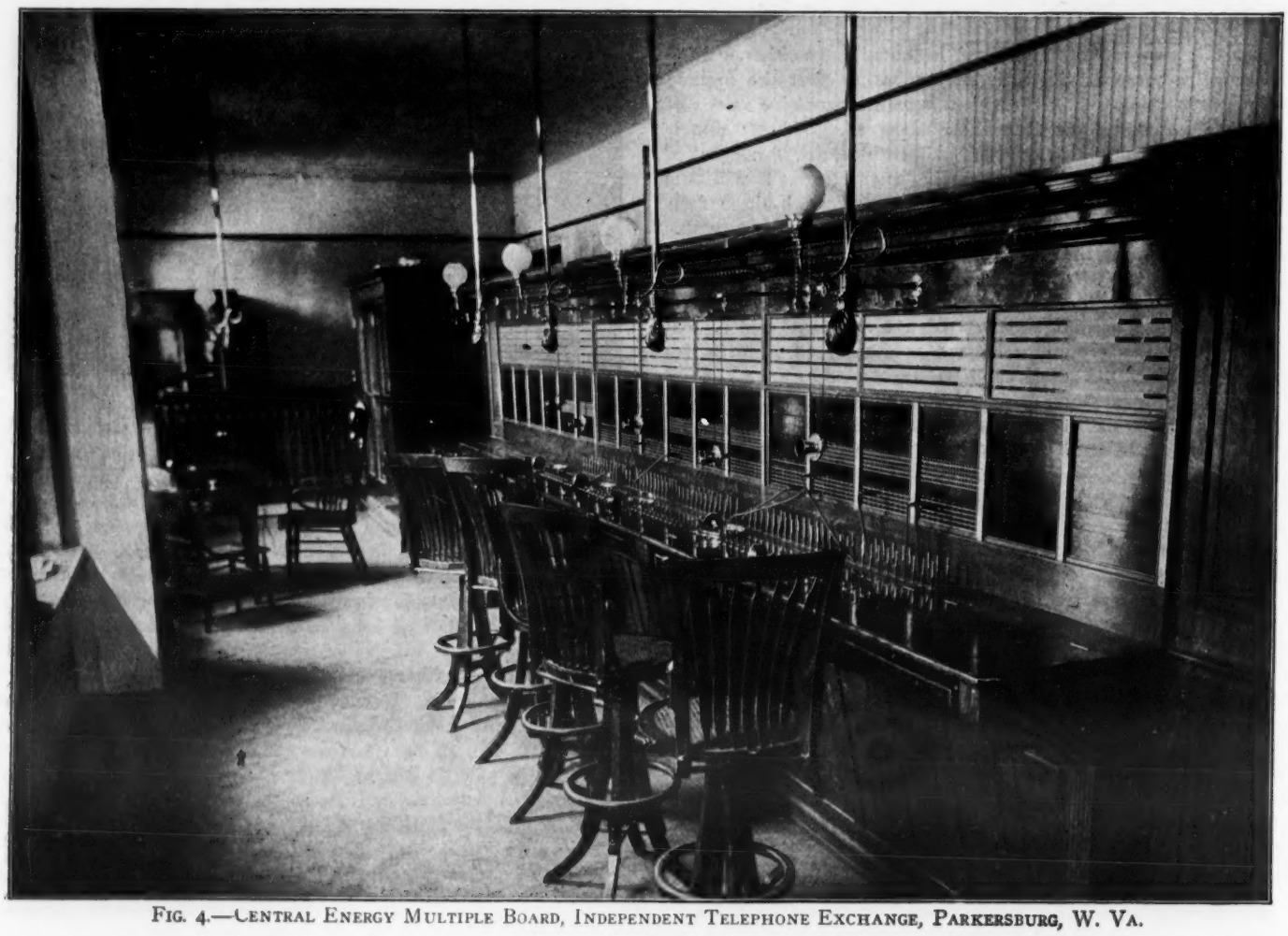


FIG. 4.—CENTRAL ENERGY MULTIPLE BOARD, INDEPENDENT TELEPHONE EXCHANGE, PARKERSBURG, W. VA.

shelf is automatically given, when the lines may at once be disconnected. The clearing-out signal is automatically restored when disconnection is made.

The line signals and clearing-out signals are given and restored electrically, leaving practically no possible way for wearing out of parts. The battery power and ringing energy for the entire exchange is furnished from the central office and controlled by the power board, shown in Fig. 2.

This board is provided with necessary switches for throwing on and off the battery plant, power generators, battery charging machines, etc., all of which are installed in duplicate, so that the exchange is fully provided for any emergency.

At the top of the power board are placed the necessary ammeters and voltmeters of the Weston type for reading the current and for properly regulating the power plant. At the right of the power board are shown the motor generator battery charging machines, of the Wagner type. The exchange is also provided with a separate motor for running the power generator and also with a Warner battery generator for emergency use.

Fig. 3 shows the main distributing board, and Fig. 5 the intermediate board case. The distributing board case placed in the main

FIG. 5.—INTERMEDIATE BOARD CASE.

switchboard room is handsomely constructed with heavy plate glass side and door panels. The switchboard frame is of heavy iron inside, well braced to make it strong and rigid; and the cabinet work is neatly designed of quartered oak and highly finished.

The wall and desk instruments of the system are of the regular "central energy" type. The user automatically signals central when taking the receiver from the hook and throws the "disconnect" signal when replacing the receiver. The telephones are all long distance and direct connection can be had with the longest toll lines. Fig. 1 gives a view of the neat pole line construction employed, the solidity of this work being in keeping with that shown throughout the system.

Another Marconi.

The *Daily News* reports that Emilion Guarini, a native of Puglia, Italy, has discovered a means of utilizing Marconi's invention at the greatest distances. He accomplishes this by means of his own invention, which is called a repeater and which he says receives the electric waves and is capable of transmitting them to other repeaters for continuous repetition. He says he needs a repeater only at every five-hundredth mile.

American Types of Automobiles.

STEARNS MODEL OF STANHOPE OR RUNABOUT.

IN the earlier stages of automobile development in this country there was considerable discussion and speculation as to whether coachmakers or bicycle builders would show most interest in the active development of this new and important field. It cannot be said that the question has yet been settled, but the drift of events would go to show, and the exhibit this week at Madison Square Garden would prove, that the coachmakers have been content to go on making merely the bodies, leaving to the bicycle builders the more difficult but surely, in the long run, the more profitable work of actual exploitation. The problems of the new art are indeed such as to appeal strongly to those who in the development of the great bicycle industry have already dealt successfully with the problems now presenting themselves under a slightly different guise. It is a commonly recognized fact that but for the evolution of the modern bicycle, the art of automobilism would still have remained stagnant or embryonic, and that it is from the lessons taught by the one that the best results attainable with the other are likely to be derived.

A further exemplification of these ideas is to be found in the fact that E. C. Stearns & Company, of Syracuse, N. Y., the well-known manufacturers of "Yellow Fellow" bicycles, have completed and tested a new motor carriage which possesses many points of excellence. In design the carriage, which is illustrated herewith, is unique, being of the lighter order of "runabout," of the Stanhope type, with sidebars and cross-body springs. The sidebars are rigidly

FIG. 1.—ELECTRICAL RUNABOUT.

attached to the rear axle sleeve by forged steel through braces, and to the front axle by fore and aft quarter springs held to the side bars about mid-length by clips and to the under side of the axle by links and bolts. The sidebars are clipped to a front crossbar with a half-spring attached to the front axle by goosenecks and links, this form of construction affording great elasticity in accommodating wheels to roadbed.

The steering mechanism consists of an improved form of ball-bearing knuckle joint close to the hubs of the forward wheels which are so connected with a centre triangle actuated by a vertical hand lever with fore and aft movement, that each of the two forward wheels is brought to a true radial position with regard to the common centre, around which the carriage may be made to turn. A slight understanding of machines will convince any one of the importance of this feature, as without it unnecessary and excessive strains are brought upon the wheels, with a tendency to roll the tires from their seats in the rims.

Wire wheels, with 3-inch pneumatic tires, of 32 and 36 inches diameter respectively, are used, of regular Stearns bicycle construction, with wooden rims. The hubs are 7 inches long, and the wire spokes are 3-16-inch. The front and smaller wheels have ball-bear-

ing hubs. The rear wheels are driven by means of a compensating gear placed upon the rear axle at the right side of the carriage. This compensating gear is not an easy thing to describe, and is not generally understood even by mechanical men. It is a positive drive upon the two wheels connected by it; at the same time it allows either to turn faster or slower than its mate, according to whether the wheels run in a straight line, or curve to the right or left. The shaft carrying the rear wheels and compensating gear runs upon ball bearings at four points, and has a clutch joint in its middle which admits of setting the wheels slightly nearer together at the botom than at the top. This feature is believed to be a strong point, and is peculiar to the Stearns carriage. By its use, the unsightly sagging apart of the driving wheels at the bottom, so common in motor carriages, is avoided, and the wheels are given just the proper undercut to bring an equal distribution of strain upon both the inner and the outer rows of spokes.

The electric power outfit of this carriage consists of a storage battery of 44 cells of 60 ampere-hours capacity. A series-wound motor of 2½-hp, capable of safely withstanding an overload up to

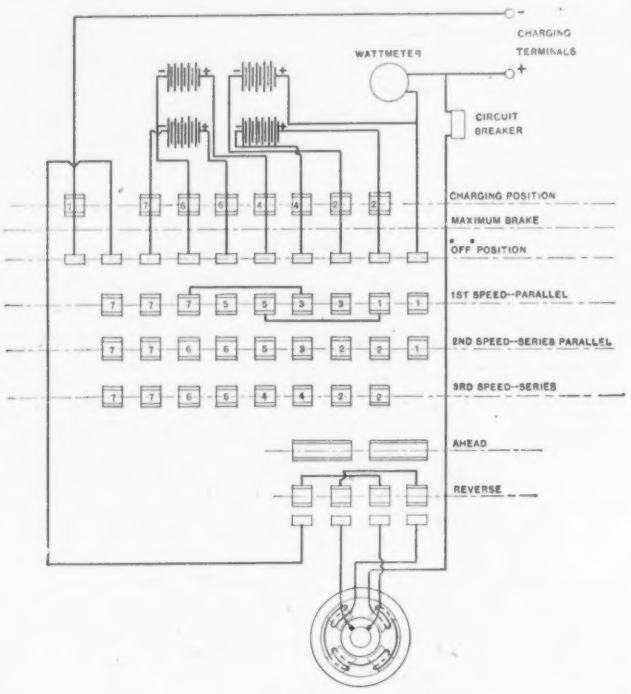


FIG. 2.—MOTOR CONNECTIONS WITH CONTROLLER AND BATTERY.

4-hp, drives the compensating gear by a rawhide pinion, the reduction being eight to one. There is a special form of series-parallel controller with three speed positions, of 5, 8 and 12 miles per hour, forward and backward, and a charging position; also a powerful drum brake upon the motor, all actuated by one lever at the left of the operator. The first speed is rarely used for running. At this point the controller arranges the batteries in four sets and in multiple. The second speed is about 8 miles per hour, and is mostly used in crowded streets and for downtown work; at this speed the controller arranges the batteries in two sets of two parallels. The last and highest speed is 12 to 13 miles per hour, and is used for boulevard runs, hill climbing, etc., and at this speed all the cells are in series, giving the highest voltage obtainable. The brake on the motor is so arranged in connection with the controller lever that the brake cannot be applied to the motor without first shutting off the current from the motor. Neither can the current be applied to the motor without releasing the brake automatically. Other features are a foot push-button for reversing the current to the motor, an electric gong located under the carriage and operated by a small button in the end of the handle of the controller lever, a charging terminal with double plug connection at rear under the end of the carriage; and the usual fuse block and circuit breaker; with a plug which may be removed and the carriage left standing safely where curious people are apt to meddle with details. A combination volt and ammeter completes the electric outfit, although it is intended to add coach lanterns and searchlight.

The carriage body, painted dark bronze green, is properly, as stated above, of the Stanhope model with deep seat upholstered in ecru broadcloth. The rear end board of the body swings outward and downward as a footboard with chain supports, and the back top hinges up to form the back of a dos-a-dos seat over the battery box, all richly upholstered and cushioned to match. The mechanical details of the carriage were built entirely in the shops of the company. Most of the small parts are of nickel, the main parts of the gear being painted a rich carmine.

The carriage has proved a complete success and a credit to the builders, having been put through a series of very severe trial runs without accident of any kind, or failure of any part, easily doing 40 miles upon one charging. It has been tested for such work, and on a quarter-mile hill of 10 per cent. grade, with its two passengers, has made 6 miles per hour.

We are indebted to Mr. H. E. Maslin, of the Stearns Company, for data used in this article and also for opportunities to inspect and test this automobile, which for some time past has been in New York City in constant service. The vehicle not only presents an unusually graceful exterior appearance, but is extremely comfortable to ride in, the motion being smooth even at the highest rate of speed. The ability to turn within a short radius is noteworthy, and upon the grades in the vicinity of Cathedral Heights and Morningside Park, it has been found quite adequate to the work. So far, the use of but one motor has proved entirely satisfactory, and the machine would appear to have a high efficiency. The total weight of the vehicle, with two passengers, 900 pounds of battery and 200 pounds of motor and controller, is only about 2200 pounds, but there is a remarkable stability and substantiality about the whole construction, guaranteeing endurance, but which would give heaviness to the general appearance were it not for the exceptionally fine, sweeping lines of the whole—a point that has still to be mastered by many excellent automobile designers.

Electrical Supply and Alternator Design.

By Alton D. Adams.

DURING fifteen years the alternator has developed from a capacity covering a few tens of horse-power, delivered at about 1000 volts, as alternating current of 8000 periods and on 1600 r. p. m., to an output of thousands of horse-power at direct-connected speeds, as either direct or alternating current, as low as 25 periods per second in frequency and as high as 10,000 volts in pressure. The alternating-current dynamo in early stations was required to supply a comparatively small load of lamps, usually at from one to several miles distant. A rate of 16,000 alternations per minute was thought desirable to reduce the cost of transformers at a given efficiency. At 1600 revolutions per minute an alternator must have 10 poles to give 16,000 alternations, and as this number of poles is more than can be used to advantage in machines under 100-hp capacity, these early alternators were unduly expensive to construct.

Since the rate of alternations is simply the product of the number of poles and the speed of revolution per unit of time, it was soon found that dynamos of several hundred horse-power to be operated at moderate speeds and also direct-connected to engines of quite slow speed, were at a decided disadvantage as to cost, because of their very large number of poles. The extending service from electric stations, with its requirements for larger units at slower speed, therefore, soon began to operate for the reduction of alternator frequencies.

Beginning with the larger sizes, a lower number of periods gradually became the more common practice, and the standard was reduced to 60 per second, or less than one-half of the former rate. Economy of copper conductors over the moderate areas served by early stations, was secured through the use of pressures of 1000 and later of 2000 volts developed in the dynamo armature; but extending radii of operation have forced up the practical figures for station pressures, until to-day supply plants develop as high as 6000 volts at the dynamo, and in some cases of long distance transmission, the armature pressures exceed these figures.

In the early alternators the armature with its windings usually revolved, and the difficulties of insulation were not found to be unduly great with pressures of 1000 and 2000 volts. With very large machines for the high pressures above named, the insulation problem was found to be more serious with moving coils than with those in a fixed position, and this was an important factor in the development of the rotating magnet and the inductor types of

alternators. The alternator with rotating magnets carries current in their windings, but this current is at so low a pressure, frequently about 100 volts, that its insulation is easily accomplished. Fixed armature core and coils in the revolving magnet alternators obviously present every possible facility for the preservation of insulation.

In the inductor alternator one step more is taken and the revolving part usually includes no windings, both those coils which receive current from the exciter and those which deliver current to the line being mounted in the stationary part of the dynamo. The entire absence of moving contacts in the inductor type of alternator is a slight advantage, as is also the fixed position of all coils. As an offset, there is the decided disadvantage that, as usually constructed, a much larger mass of iron must pass between high and low degrees of saturation at each alternation of current in the generating coils of an inductor alternator than in those of either the moving-armature or the revolving-magnet type. A result of this change in magnetic condition of the iron parts of inductor alternators is not only that their saturation must be rather low to avoid large hysteresis losses, thus making a heavy machine, but a larger part of the dynamo must be carefully laminated to avoid local currents than is usually necessary when either the magnets or armature revolve. The alternator with revolving armature, whose teeth are properly shaped, does not require laminated magnets, and when the magnets revolve within a suitable armature, their lamination is not necessary.

The reason for good results with solid magnets in these two last cases is that the saturation of the magnets remains nearly constant. As the entire magnetic circuit in inductor alternators is subject to a wide change of magnetic condition at each alternation of the current, the parts in which these magnetic changes take place constitute a great part of the frame and add to the expense of construction. When alternators of the inductor type are bought, it is especially desirable not only to have the usual guarantee as to efficiency in the contract, but also to make the too unusual test for efficiency before the dynamo is paid for.

For alternators up to several horse-power capacity at ordinary station voltages, the revolving armature type is most preferred by American manufactureres, and is probably the cheapest to construct for given results, especially at speeds common in belt driving. For those cases where very high pressures are to be generated in the armature coils, the revolving-magnet type or the inductor type of alternator seem more suitable, especially as these extra high pressures are usually wanted in plants for long-distance power transmission, where large units at the low speeds of direct connection are to be used.

Considerable as has been the influence of electrical supply conditions on the design of alternators in the past, it seems probable that these conditions will be given even greater weight from now on. One of the strongest tendencies at work in central station design is that toward a uniform character of electric generating equipment. At the same time, it is now generally recognized that heavy, concentrated loads near the station can be more economically operated without the intervention of transformers, and that direct currents usually are preferred by consumers for such loads. A station equipped entirely with alternating-current generators may, of course, supply adjacent loads, as well as those more distant, with direct current by means of the necessary transformers and rotary converters; but this involves an unnecessarily high first cost and low subsequent efficiency of operation as to nearby loads.

In the matter of traction plants for the extended electric railway systems so rapidly being developed, a similar problem to that of general electrical supply is presented, involving the delivery of large amounts of direct current at comparatively short distances from the generating station, and still other similar amounts at distances so great as to render transmission by alternating current necessary. It now seems evident that the best generating equipment for the average electrical supply station and the plant of an extended traction system, should include double-current dynamos, or rotary converters, for the main instead of the auxiliary machines, thus avoiding an unnecessary transformation for a large part of the output. Even in those cases where for any reason it is thought best to deliver all current from the main generators in the alternating form, the double-current dynamo, used as a rotary converter, must handle more or less of the electric energy before its final distribution for consumption.

The extensive application of double-current dynamos, whether as power-driven main generators or as electrically-driven rotary converters, must obviously operate for the development in these machines of structural features suitable to the satisfactory delivery of both direct and alternating currents. Generators for the delivery of only alternating currents operate equally well whether the armature coils are fixed or rotate; but if direct currents are to be secured from stationary armature coils, the brushes must rotate and this has not been found desirable. It is, therefore, a practical necessity that double-current dynamos or rotary converters have rotating armatures.

One of the main objections to moving armature coils—the difficulty of insulation at high pressure—does not apply to the case of double-current dynamos and rotary converters, because the direct current from or to these machines is seldom or never at sufficiently high pressure to make the problem of insulation serious. As the ordinary double-current dynamo or converter has but one armature winding, from which either direct or alternating currents may be delivered, or into which either sort of current may be sent, the limitations as to the pressure of its direct currents apply also to the alternating.

The most serious problem to be met in the design of dynamos for the receipt and delivery of both direct and alternating current at usual frequencies, is the satisfactory commutation of the direct current. It has not been found desirable to reduce the number of armature slots and commutator segments to less than about 20 per magnet pole, and even this number is decidedly below that generally found in purely direct-current dynamos. On the other hand, the more common frequencies now in use for alternating currents require such large numbers of poles at ordinary speeds of direct connection, that special proportions for armature cores and slots must be adopted in order to meet requirements as to commutation in double-current machines. These special proportions are of so radical a nature as to add very materially to the cost of a machine by giving it an excessive diameter as to its armature, and a great number of armature slots and commutator segments.

This may be illustrated by reference to a direct-connected double-current generator to operate at a speed of 150 revolutions per minute, as do the machines of this type installed at the station of the Chicago Edison Company during 1898. At the prevailing rate of 60 cycles per second or $60 \times 60 \times 2 = 7200$ alternations per minute, such machines would require $7200 \div 150 = 48$ poles, and allowing only 20 armature slots and 20 commutator bars per pole, the number of each would be 960. The double-current generators at the Chicago Edison Company's station were designed for a frequency of only 25 periods per second, corresponding $25 \times 60 \times 2 = 3000$ alternations per minute, and the number of poles at the speed of revolution named is, therefore, $3000 \div 150 = 20$. Even this number of poles, however, is larger than is desirable in a direct-current dynamo having the capacity of those above named, that is, 200 kilowatts.

The frequency of 25 cycles per second was probably selected at the Chicago plant, as in other cases, because experiment has proved that this is about the lowest rate of change in current direction that is satisfactory in incandescent lamps to the great majority of users. When the rate of alternation drops much below 25 cycles per second, say down to 20, a decided waver can be detected in the light from an incandescent lamp, due to the fact that the 40 periods per second during which no current flows through the lamp filament are each long enough to allow a perceptible reduction in its temperature and incandescence. The lowest practical rate of alternations having been reached, the only other resource for the reduction of the number of magnet poles in rotary converters and double-current dynamos is to obtain the highest practical speed of rotation for each case. Thus, could the speed of the double-current generators at the Chicago Edison station have been increased to 300 revolutions per minute, the number of poles to give the desired frequency—3000 alternations per minute—would have dropped to $3000 \div 300 = 10$, not a bad number for a 200-kw direct-current dynamo.

At the ordinary belted speeds of small and medium alternators, it is not difficult to unite a suitable frequency of alternations and a capacity for good commutation in a dynamo of normal proportions. Taking a speed of 750 revolutions per minute as a common one for a belt-driven alternator of 75 or 100 kilowatts capacity, it appears that the poles necessary to give 3000 alternations per

minute are only, $3000 \div 750 = 4$, a number common in direct-current generators of this capacity and speed. If six poles or a somewhat higher rate of alternations are desired for this case, they can be had with good machine proportions, good commutation and 37.5 cycles per second.

The conditions of small central stations as to amounts and locations of loads are frequently similar to those in large cities, on a less scale, and they may well take advantage of the opportunities offered by the double-current generator for economical operation and distribution. Electric systems in places of moderate size are not hard to find, with transformers thickly scattered about within one-half and even one-quarter of a mile from the station, a visit to which latter often reveals a direct-current dynamo driven by a partly loaded engine and supplying a motor load, while another engine, with little to do, rotates the alternator. A double-current generator, operating both the lamp and motor lines from one loaded engine, would cause the removal of nearby transformers and perhaps surprise some stockholders who never saw a dividend.

Convention of Northwestern Electrical Association.

THE eighth annual convention of the Northwestern Electrical Association was held at the Hotel Pfister, Milwaukee, Wisconsin, Wednesday and Thursday, January 17 and 18. The attendance was considerably less than usual, but this did not show any slackening of interest in the objects of the association, as the excuses sent to the secretary invariably referred to the great activity of the business situation as the cause of absence. At no previous meeting was greater interest manifested in the proceedings, both those relating to the general business of the association and the discussion of the papers, which latter were thorough and more than usually to the point.

The convention was opened at noon, Jan. 17, President Henry L. Doherty in the chair.

All of the session was taken up with business matters. Prof. Dugald C. Jackson submitted the report of the committee on by-laws, which led to a lengthy discussion. The more important changes in the by-laws which the committee considered were as follows: That the directors be given the privilege of fixing the date and place of the annual meeting; that the order of business be so changed that the election of officers will come nearer the annual convention; that the board of directors shall be empowered to alter the classifications of individual members at their discretion; that the status and election of honorary members shall be improved.

As to the first point, the committee recommended an amendment to the effect that the annual meeting of the association shall be held on the third Wednesday in January, and not more than two days following, at Milwaukee, Wis., unless a letter ballot taken under the direction of the board of directors at least three months before the date of the meeting shows by the majority of votes cast that the time and place of the meeting, or both, shall be changed for the year. It was also recommended that the retiring president shall present an address setting forth his official acts and such other suggestions and recommendations as he shall deem to be of value to the association.

As to the second proposition, the committee unanimously recommended that officers be installed toward the end of the convention in order that each convention may have the advantage of a year's reflection on improved policies on the part of the president before he is made responsible for the procedure of the convention.

With respect to the third proposition, a new classification of members was recommended, and the report on the fourth proposition was that honorary members shall include only those who have conferred marked favors on the association, or whose reputation may confer distinction thereupon through their election.

In the discussion of the first proposition concerning the question of time and place of meeting, the opinion was generally expressed that the sense of the association at large could not be obtained by sending out letters, owing to the fact that many would not send answers.

Mr. Doherty pointed out the advisability of amending the by-laws so that if it became desirable to meet at any other place than Milwaukee, the necessary arrangements could be made, which would be impossible under the present by-laws. The entire matter covered by the report was finally referred to a committee, to be presented again later in a shape suggested by the discussion which had taken place.

At the afternoon session of Jan. 17, Secretary Mercein submitted his report for the year, which dealt largely with action taken on legislative matters. The report was accepted by an unanimous vote, and the secretary complimented upon the manner in which he had performed his duties during the year.

The report of the protection committee was then submitted. It referred to an effort made to increase the rate of taxation on electric plants, but after a hearing from a number of men interested in the electrical business, an act was passed by which all the electric lighting plants of the State of Wisconsin, except such as combined street railways and electric lighting, were to be assessed by the local assessors and the tax paid into the local treasury. Attention was called to the fact that the legislature had provided for a board of tax commissioners, with authority to regulate the taxation of all property in the state, and recommended that representatives of the electrical industries appear before the tax commissioners and present their views.

Mr. R. Fleming then read a paper on "Modern Developments in Alternating Current Series Arc Lighting," an abstract of which will be found elsewhere in this report.

Prof. Jackson followed with a paper entitled "Alternating Current Phenomena," which will be reprinted in these columns in a following issue.

The morning session of Jan. 18 was opened by a paper by Mr. W. H. Schott on heating from central stations, which is abstracted in another page.

After the discussion of the paper by Mr. Schott, Mr. Frund read a paper on "Central Station Economies," an abstract of which appears elsewhere in this issue.

Upon the conclusion of the discussion of the paper by Mr. Frund, a paper was read by Mr. Ralph Mershon, entitled "The Induction Motor," a reprint of which will appear in a following number of this journal.

Upon the conclusion of the discussion of Mr. Mershon's paper, Secretary Mercein stated that President Doherty had expended considerable money during the year on the objects of the association which he thought the association should reimburse. President Doherty, however, refused to accept any payment.

At the opening of the afternoon session, the following officers were elected for the current year: President, Mr. Pliny Norcross, Janesville, Wis.; first vice-president, Mr. H. W. Frund, Vincennes, Ind.; second vice-president, Mr. H. J. Gille, St. Paul, Minn.; secretary and treasurer, Mr. Thomas R. Mercein, Milwaukee, Wis.; directors, Messrs. Schott, Westover and Innes.

Upon the announcement of the ballot, President Norcross was escorted to the chair, and in accepting the honor conferred upon him, spoke of the great good that had been accomplished by the association in bringing together central station managers and superintendents for the exchange of views. In no way, he thought, could the owner or a central station manager spend money to better advantage to himself or his interests than by sending a superintendent or foreman or some of his best men to the meetings of the association.

Upon the conclusion of President Norcross' remarks, votes of thanks were extended to the retiring officers and to Mr. Mercein for the manner in which they had accomplished their duties during the preceding year.

A committee on memorials presented a report paying a tribute of respect to the memory of the late Mr. C. C. Paige.

A report of a committee was adopted providing for a summer meeting at Waupaca, Wis., on a date to be fixed in the future.

Prof. Jackson resubmitted the report of his committee on the changes in by-laws, with some amendments. The proposed time and place for holding the annual meeting elsewhere than at Milwaukee shall be determined by letter ballot, and notification shall be sent out containing a statement of reasons for which it is desired to make the change. Another amendment was that applications for membership shall be submitted to a membership committee appointed from those in attendance on the convention.

Prof. Richter, of the University of Wisconsin, then read a paper entitled "Relative Desirability of Various Sizes of Engines on Cen-

tral Station Loads," an abstract of which appears in another part of this report.

The incoming president was instructed to take up the subject of classification of freight rates with the committee of the National Electric Light Association.

After a discussion of Prof. Richter's paper, Mr. Marsh, in the absence of Prof. Shepardson, read his paper on "A Life Test of Incandescent Lamps," an abstract of which appears elsewhere.

The convention then adjourned, no sessions being held on the following day, as originally intended.

PRESIDENTIAL ADDRESS.

In his presidential address, Mr. H. L. Doherty referred to the remarkable activity and prosperity which characterized the year just closed. The central station business, he stated, is dependent upon the general prosperity of the community, though both good and bad results seem to lag behind prosperity and adversity in other channels. Average reports from this industry indicate a great increase in economy, but also a marked increase in cost of material. It is evident, however, that the increased business gained at this time will continue even after the market for material has again reached its equilibrium.

The beneficial effects of good wages were dwelt upon, and it was stated that the effect of trusts is to make it possible for the workingman's condition to be greatly bettered. Prior to their formation wages could be only materially increased by universal agreement, while now in many instances competition is almost eliminated, and if the condition of the workmen employed by the trusts is not bettered, the officers—not the stockholders—are open to severe criticism.

In sketching the progress made in central station machinery, Mr. Doherty said that the exploitation of the electrical business has done much toward the development of steam practice, and while there have been no marked improvements—except possibly in the case of the steam turbine and higher steam pressures—the operating results have been materially bettered. The opinion was expressed that the constant-current transformer is here to stay, and that street illumination by series alternating enclosed arc lamps appears to be a decided improvement over the old series direct-current open arc. The distribution of light is very materially improved and the serious objection to the old open arc of lack of uniform illumination has been partially obviated.

Reference was made to the introduction of gas engines into the central station field, examples being quoted of two central stations which have adopted them as prime movers, using sizes as high as 650-hp. Aluminum was pronounced a satisfactory substitute for copper conductors, and the advisability pointed out of using aluminum wire as much as possible to assist in bringing the price of copper to a more reasonable figure. The use of exhaust steam for heating neighboring buildings either by dry direct transmission or the circulation of hot water, is being adopted by numerous plants. The manufacture of producer gas was commended as a subject worthy the serious attention of engineers, for even under present conditions producer gas and gas engines will yield a unit of energy for the least consumption of fuel. An advantage of the producer gas furnace is that, unlike boilers, it has about the same efficiency at all loads; in addition gas can be stored, while the storage of steam is almost impossible and the storage of electrical current is not always practicable or economical.

The necessity of a better distribution of street lighting was referred to and the statement made that the incandescent lamp may yet prove a formidable field factor in this field. As to the details of central station business, it was stated that there has been little improvement in direct-current methods in the past few years, but a most marked improvement in alternating-current appliances and methods. "Unaccounted for current" in alternating-current stations has often amounted to 80 per cent. of the output and 60 per cent. is more nearly the average than the extreme. Modern transformers, up-to-date methods and equitable rates should reduce this loss to an almost negligible amount. The average central station is handicapped for the following reasons: 1. Improper and insufficient education of operators. 2. Poor accounting. 3. Lack of capital. 4. Inequitable rates. A strong plea was made for the selection of the best educated men in different branches—the choice of the most highly educated talent a position will command. A further education of present employees is also recommended, and in this connection the value of correspondence schools was referred to in complimentary terms.

As to accounting, if intelligently and carefully done each item of total expense would be determined and compared with previous methods, or with results in other plants. Good scales, engine indicators, recording station wattmeters and consumers' house meters will enable daily determinations of boiler efficiency, combined engine and dynamo efficiency, monthly determinations of line, transformer and meter efficiencies. In many instances it is advisable to go even further than this and use primary meters on every bank of transformers, and thus check the accuracy of consumers' meters by districts. Each separate item of cost should be accounted for separately, and put in a form to be compared with the data of similar periods. Wherever possible the cost should be with reference to the kw-unit.

The necessity of some equitable method of charges was stated to be of greater importance than the attention given to the matter would lead one to believe. Sliding scale meter rates are condemned, while the Wright maximum demand system and the two-rate meter system are pronounced steps in the right direction, but not to be regarded as anything more than makeshifts. The plan of charging a certain rate for the complete installation for the first hour, and a lower rate for each successive hour was pronounced more equitable than either, and far more simple.

The subject of municipal ownership was discussed at some length, and the conclusion arrived at that the main protection against its application lies in the education of the people as to its fallacies.

Referring to the offer made at the convention of the League of American Municipalities to bear half the cost of investigation of twenty municipal electric plants, to be selected by the president of the league, in order to determine the true cost of service in comparison with the rates charged by private plants, it was stated that the league failed to accept the proposition in a manner to insure its objects. Their acceptance on any terms was only secured by great effort, and so far no effort is being made by the league to provide funds to carry out the conditional arrangement agreed upon. Mr. Doherty recommended that the association solicit subscriptions and guarantee enough money to add to that collected by the league to make up the necessary amount of $2500 pledged by it.

As to legislation, Mr. Doherty stated that in general all the central station interests asked was to be let alone. Better protection, however, should be given against thefts of current and a permanent method of taxation should be decided upon. As a matter of justice and for the sake of developing our natural resources, companies developing water powers and transmitting electrical energy through long distances should be granted the right of eminent domain. Interference with high-voltage transmission should be so severely punished as to offer the most complete protection to these properties. The unjust discrimination against electrical goods by their freight classification was referred to, and members were called upon to use their personal influence to convince the railroad men of the gross injustice of the present classification.

MODERN DEVELOPMENT IN ALTERNATING-CURRENT ARC LAMPS.

In opening his paper having the above title, Mr. R. Fleming stated that series lighting by direct currents has for many years past reached a degree of perfection which it is doubtful can be improved upon, especially with respect to generating and distributing the current. The objection to direct-current lighting is the lack of flexibility. With this system it is necessary to have, for high potential work, a small generating unit of comparatively low efficiency, this in turn being driven by a small engine of low efficiency and from a line shaft of still lower efficiency or by a synchronous motor, which latter method has also its disadvantages. Alternating-current arc lighting enables to be realized the ideal condition of a central station plant capable of furnishing all manner of light and power from a single unit or single class of units of a size large enough to enable them to be operated under all possible conditions, and of the highest efficiency, electrically and mechanically.

For open-arc alternating-current lamps there is required a special generator with extremely high armature reaction and separately excited. This method has thus all the disadvantages of a direct-current system of distribution as well as a great many others inherent in itself. In addition, the lamps are noisy and give off a light of poor quality. The advent of the constant-current transformer and the alternating enclosed lamp has changed the whole aspect of arc lighting from alternating-current circuits. With these transformers it is possible to do anything that can be done with any form of direct-current arc generator. The regulation is as good or ever better than can be obtained from direct-current machines, and this without the use of external complicated means of regulation, these transformers possess-

ing the qualities of inherent regulation. With this system it is entirely feasible to completely short circuit the secondary winding of the constant-current transformers and without further manipulation apply the primary current at full potential without in the least damaging it and with extremely slight disturbance to the circuit to which it is attached.

As to lamps, the difficulties in the way of making a satisfactory series-alternating lamp have been very considerable. Owing to the nature of the current applied to the lamps, it was difficult to overcome the noise and vibration of the mechanism, and the behavior of the arc was extremely annoying, while the nature of the carbon entered largely into the problem. This problem, however, is stated to be now fairly well solved and a commercial lamp produced capable of doing its work equally as well, if not better, than the best direct-current lamp of similar nature. The alternating lamp is fully the equal if not the superior of the direct-current lamp, especially for street lighting, owing principally to the improved distribution of light from the alternating arc.

The paper refers to a proposition to mount a constant-current transformer on a truck, this to be stored at some convenient point; in case of accident, a team can then be hitched on and driven to the point where the trouble has occurred. So far this plan has not been put into practical operation, yet the author considers that it has all the essentials of success, and would be an excellent means of providing service in case of breakdown. A breakdown of this system, however, is a remote possibility, owing to the construction of the transformer and the provision made against accident due either to internal strains on the insulation or the possibility of damage by lightning.

The experience of a central lighting company is quoted to the effect that the saving made by the use of the constant-current alternating system over the old system of direct-current open arcs will pay for the new system within two years. The cost of operation of the series-alternating system is very nearly the same as regards the labor for trimming and the cost of carbon as for the direct-current enclosed arc lamp. In a number of cases it has been estimated that in changing over from open arcs a saving of from $8 to $10 and in some cases as high as $12 per lamp per year has been made. With the new system one man is abundantly able to take care of 600 lamps where it required six men to take care of an equal number of open direct-current arcs. The enclosed-arc alternating lamp does not require to be trimmed more than once a week under the most severe conditions.

Some figures are given as to the percentage of inner globe breakages. For direct current this varied from .48 to 6.6 per cent. and for alternating current from .18 to 5.5 per cent. These figures show that no definite result can be arrived at. A great deal depends upon the care with which the cleaning and trimming of the globes is performed. The energy consumed by the lamps seems to have little bearing on globe breakage, as the life of globes burning at 7 or 7½ amperes and consuming 500 watts or over is as good as those of 4½ of 5 ampere lamps which only consume 400 watts or less. As to the proper amount of energy that a street lamp should consume, it is stated that a current of 6.6 amperes with an arc adjustment of 70 volts seems almost universally satisfactory. The volume of light from such a lamp is certainly large enough for street illumination, and in special cases where a greater amount of light is required, it is far better to increase the number of lamps rather than increase the power of the lights themselves.

The discussion of Mr. Fleming's paper was participated in by Messrs. Allen, Gille, Doherty, Werdact, Frund, Bean, Livermore, Cutter, Debell, Armour, Copeland, Prestiss, Brooks, Innes and Prof. Jackson.

Mr. Allen said that his experience with constant-current alternating enclosed arc lamps had been very satisfactory. These lamps replaced 1200-cp direct-current open lamps and every one of the customers was better pleased with the new lamps. There is less noise from them than from the old style open lamps, while the regulation is extremely close. Mr. Fleming in answer to a query as to transformer substations stated that they required very little attention. In one case the rule is to get to the substation at the time of starting it and put the transformers into operation; then have an inspector visit it at midnight and again in the morning to cut off the transformers.

Mr. Werdact said that about 3000 32-cp 5-ampere series incandescent lamps installed on series transformers are used by his company. It has been found by experience that no particular hand regulation is required. To provide for short circuits and serious troubles circuit breakers are used in connection with all the transformers with a relay attachment which works within about 5 per cent. An efficiency of from 95 to 96 per cent. is obtained in this series system. The series lamp will maintain its candle-power surprisingly long, many lamps having burned 10,000 hours and some as long as 18,000 hours. At 10,000 hours the candle-power will drop to about 25 and some even as low as 20. The small amount of drop is due to the fact that the resistance of the carbon increases with time and so brightens up the lamp. After being up about 2000 hours the lamp darkens somewhat. The average life is from 4000 to 5000 hours. The system is found to be a very efficient one, and Mr. Werdact believes that the day will come when series alternating current incandescent lamps will be generally used in residence districts for street lighting. With 300 or 400 lamps on a circuit, over a dozen may break and make very little difference in the voltage of a single lamp. Two kinds of cutouts are used, one being the ordinary paper film cutout and the other the shunt coil.

Mr. Frund corroborated Mr. Werdact as to the life of series incandescent lamps. His company has about 205 lamps in series, and the renewals last year averaged but ten a month, which corresponds to 5000 hours per lamp. After 2000 hours the globes become somewhat dark, but it is not so noticeable as to cause complaint.

Mr. Fleming mentioned an installation where transformers of a capacity for from 500 to 600 arc lights are set up, but with only 100 arc lamps on the circuits, the balance of the capacity being used for series incandescent lighting. In this case, the constant current transformer is used, its advantage being that the destruction of lamps is practically eliminated in the case of a short circuit.

In reply to a question as to the economy of the series incandescent lamp, Mr. Werdact said that it would range from 95 watts when new to 110 watts after 4000 hours. Such lamps have a critical period at the end of about ten hours, and if they pass that period they will last many thousands of hours. One reason for the good results obtained from series lamps is the small variation of voltage at the terminals of a single lamp. In St. Louis the alleys and many residence streets are lighted by this system. The lights are suspended from pole-arms about four feet long, the poles being all on one side of the street.

In answer to a query as to the use of reflectors, Mr. Fleming said that in some cases they are used on series alternating-current enclosed lamps, but he would not advise their general adoption. They make a difference of a dollar or two on the original investment and save the light that would otherwise be reflected above the horizontal.

In reply to a question as to the best size of arc, Mr. Fleming said that much satisfaction is given by a lamp consuming from 425 to 440 watts at 6.6 amperes and 70 to 75 volts at the arc. In some cases 7½-ampere lamps are used, but this size is not really necessary. Open arcs and enclosed arcs are about equal at 50 feet, but beyond that the illumination is increasingly better from the enclosed lamp. The constant-current transformer will regulate clear down to short circuit and have an efficiency of from 96 to 97 per cent. on large sizes, and on the smaller size an efficiency of 95 per cent. is easily obtained.

Mr. Cutter cited an instance of a station equipped with six or eight old style 25 or 30-lamp T-H arc machines, a bipolar 500-volt machine for a motor circuit and two old type alternators. This collection has been replaced with one large generator, all motors being replaced by alternating-current motors and the arc lamps by the new type operating from constant-current transformers.

Mr. Armour said it is a question whether the direct-current enclosed lamp at a distance of 150 feet from the pole gives as good a result as the alternating enclosed lamp. The first cost of installation of the former would be less, however. At an angle of 50 degrees the light is much stronger from the direct than from the alternating lamp, but at further distances they are about the same. While more light may be gotten with the direct-current lamp, it is objectionable from the fact that when passing into the sphere of light the eye adjusts itself to the greater intensity, and in coming out it seems much darker than it otherwise would.

Mr. Allen said that in Springfield, Mass., a distinct improvement in illumination was noted when alternating enclosed arc lamps were substituted for direct-current enclosed lamps. While he could not say which lamp gives the most volume of light, the comparison with respect to distribution was in favor of the alternating lamp. In comparing the light from an enclosed and open direct-current lamp standing at an equal distance from the two lamps, the distribution of light was much better from the latter, but within a radius of 100 feet

and underneath the lamps, the direct-current lamp gave a much better light.

Mr. Cutter said that it is plain that beyond a certain short distance from the lamp itself, the comparison continually grows in favor of the alternating arc.

Prof. Jackson called attention to the fact that light and illumination are two different matters. How much light a lamp gives out is one thing, and the character of the illumination, which is largely a physiological matter, is another thing. Illumination which is comparatively weak but uniform, will give much better satisfaction than a stronger light with irregular illumination.

Mr. Cutter, in referring to some tests of lamps, said that an open arc which gave a candle-power of 2080 along the maximum ray gave a mean spherical candle-power of only 360. Prof. Jackson said that the mean spherical illumination of a light giving 1900 to 2100-cp along the maximum ray, would be perhaps 300 to 400-cp, and that the spherical illumination of a good enclosed lamp would be very nearly as much whether alternating or direct current. Mr. Brooks said that the loss in the best make of direct-current lamps was from 150 to 175 watts, while in the same make of alternating lamps it was only 50 to 60 watts.

CENTRAL STATION HEATING IN CONNECTION WITH ELECTRIC LIGHTING PLANTS.

In his paper with the above title, Mr. W. H. Schott said that after an investigation of both exhaust and hot water systems of heating, he is convinced that while for certain cases the exhaust steam system of heating, either using back pressure on the engines or a vacuum pump, would be advisable, yet where an extensive district is required to be covered, extending over scattered areas, it is impracticable on account of the heavy investment required. The hot water system, however, in towns where the business is located within two miles of the power station, can be installed from one power house and at a minimum cost compared with the exhaust steam system. Smaller pipes may be used to do the same amount of work; they require less expensive insulation on account of the lower temperatures and less expansion joints are required; moreover, with the hot water system heat can be stored up during such times when there is a surplus of steam and utilized when the amount of steam going to waste would be insufficient. In addition to offering uniform heat to the consumer, hot water for bath and laundry purposes can also be sold to him, which further business will probably amount to 30 per cent. of the whole. The average electric lighting plant in smaller cities is dependent on the city lighting contract, and in case the contract is lost the investment may be destroyed. A heating plant which utilizes exhaust steam would provide against this emergency, for normally it would give a market for the by-product, and the station could be run as a central heating station should the lighting contract be lost.

In the discussion, Mr. Doherty said that in figuring out the thermal capacity of water and steam, he finds that the latter has a heating value ten times greater than that of the former. On the other hand, the thermal capacity of water is much higher than that of steam, but water cannot travel at anywhere near the velocity that steam can without much greater loss.

In reply to a question as to the ratio of the income to the investment per annum from heating, Mr. Schott said that when his plant is fully loaded it will be about 65 per cent. Mr. Doherty said that 33 1-3 per cent. is the ratio that others have given, but that this depends, of course, on the density of customers in the district supplied.

Mr. Schott said that in the case of his plant they started taking on business 400 feet from the station, and at 700 feet from the station they have an income of $1600; in three years they anticipate securing an average capacity to take care of fully $20,000 worth of heating business. The ordinary type of steam radiators cannot, he considered, be used for hot water heating, but Mr. Copeland added that in the case of his plant they utilized the steam radiators. In one building where there were 3200 square feet of steam radiation it was replaced with 5000 feet of radiation from hot water. Mr. Copeland said that the present income from his heating is $4600 from 39 customers, and that the system runs out a mile and a quarter. No difficulty is found in keeping the houses warm and the water does not flow through the house more than one-fifth of the time, a thermostat allowing a variation of 2 degrees and closing off the water entirely when the temperature exceeds the maximum. A pump pressure of 45 pounds is used to force the water.

Mr. Stahl said that in a schoolhouse the steam radiators were adapted to use hot water with very little expense. The school was heated with hard coal, and hot water heating is supplied for the amount that had been paid for the coal. Mr. Stahl said that on the systems he has installed, the pump is merely used to overcome friction, an expansion tank being placed at the altitude of the highest radiator. About 50 per cent. more radiating surface is needed with hot water than with exhaust steam. In many places, however, the steam radiator could be used with the hot water system. Referring to the size of pipes, Mr. Stahl stated that if a pipe 14 inchs in diameter is required to handle a certain supply of heat for a certain amount of radiation from steam, a pipe 8 inches in diameter will be sufficient for water.

Mr. Schott said that the cross-section of pipe required is practically one-third less for water than for steam. In the case of a large asylum having 6500 feet of radiation, an inch supply pipe was sufficient, and the differences of pressure of the incoming and outgoing water is 5 pounds.

Mr. Stahl said that steam heating plants charge 25 cents a square foot for steam radiation, which corresponds to 18¾ cents for hot water radiation. In point of fact, the prices that are being charged for the latter are only from 12½ to 15 cents, though some are beginning to charge 18 and 20 cents.

As to the supply of hot water, Mr. Schott said that his company agreed to circulate water from the incoming pipe three times a day through the coil of a hot water boiler for the purpose of heating water. Mr. Copeland said that his customers are allowed to attach the heating coil of a hot water boiler, but it can only be tapped into the return pipe.

To prevent stealing water, it was suggested to put a package of aniline in the circulating water.

Mr. Stahl spoke of a method whereby exhaust steam after heating the water for circulation, passed to a jet condenser of the engine; in this manner, the circulating water was heated without impairing the effect of the condensing apparatus. Though less heat will go in the water of circulation, Mr. Stahl believed that the plan can be satisfactorily put into execution. Mr. Fleming considered the plan impracticable and the same criticism was made by others in the discussion.

CENTRAL STATION ECONOMIES.

Mr. H. W. Frund in a paper with the above title, said he would confine his remarks more particularly to central stations in cities having less than 30,000 population, which comprise 90 per cent. of all the central stations of the United States.

The care of meters formed the principal subject of the paper and stress was laid upon the fact that they should be sealed so that insects attracted by the warmth cannot enter and eventually cause a slowing up of the meter. Recently meters have been very much improved, particularly those of the watt-hour type, for which class the cost of inspection and repair is very largely reduced. It is recommended that old type meters should be made impervious to disturbing elements by the use of putty for sealing the cases and terminal posts. Before doing so, however, the meters should be examined and new shafts and jewels put in if found necessary. A case is cited where the expense during the first year for repairs to meters was $20. All were then brought into the station, overhauled, cleaned and repaired, and in the succeeding four years the expense has not been $5. Watt-hour meters are pronounced to be superior to ampere-hour meters and the use of the latter is not recommended. Every central station should have a meter book in order to keep close account of each meter, including the date of purchase, when placed for service, when taken out and returned, and memoranda of the times of testing, cleaning, etc.

Mr. Frund very strongly recommended a proper system of accounts and books which will enable all different kinds of expenses to be charged separately. With such a system in a few minutes the cost of any part of the service can be obtained. As an example of the benefit to be derived, in one case before adopting the system recommended the waste bills for the year before were $43.80 and the year following less than $10. This saving was enabled to be made entirely through the items being separated, which indicated the unnecessarily large size of the waste item.

In the discussion of Mr. Frund's paper Mr. Debell said that several months ago he wanted to get up a new customers' ledger, and after writing to a number of central stations, he learned that none seemed to be satisfactory to those who were using them, and many replied that they were themselves looking for a good form.

Prof. Jackson spoke of the great importance of accurate recording apparatus and proper bookkeeping. One of the objects of the latter should also be to show how much of the different expenses shall be charged to different parts of the distribution. He said that the association spends hours in discussing new apparatus, and, as a rule, pass over the real difficulty, which is the proper operation of the present station. On this latter point Mr. Bean agreed with Prof. Jackson, and said that instead of buying new apparatus it would be well to learn how to use the old to the best advantage. He also coincided as to the value of the use of recording instruments.

Mr. Doherty said that there is no one item that would increase central station profit as much as good accounting. In recent examinations of over twenty electrical plants he found the greatest disparity in figures, largely due to neglect of proper accounting. In reply to a question he said that the cost per kw-hour with fuel at $3.60 would be high above one cent and good below three-quarter-cent.

Mr. Copeland having spoken of a load the peak of which was 1400 amperes on a side, and the low point 150 to 175 amperes, Mr. Doherty thought if it was a one-hour peak, the cost he mentioned could not be attained. If the 1400 would, however, average about 1000 for three hours, the cost per kilowatt per hour for fuel might be gotten down to one cent. He said that the loss between the station and the consumer's meter for a direct-current plant ought to be less than 10 per cent., although it generally runs over 30. In an alternating-current plant the best that he knew of was 35 per cent. and the worst 88 per cent.

Prof. Jackson said that it would be perfectly feasible with a comparatively little expenditure of money to have new apparatus bring the average alternating central station to a point where perhaps as much as 80 per cent. of the station output would be paid for by the consumer. Careful management, however, must be employed in every way, and especially in measuring the output and seeing that the current delivered to consumers is properly measured. Most of the loss is in transformers and the consumers' meters. In many stations, however, great loss is due to bad firing, to bad boiler settings and poor piping.

Mr. Doherty said he generally figures core loss per kw-hour at three-quarters of a cent and copper at three cents. At the Madison, Wis., station the efficiency runs close to 70 per cent.

The question being asked, how many central station men present had station meters on the switchboard to record their output, nine members stated that they had and ten that they had not. Mr. Doherty said that when he first came into the association not a single member had a station wattmeter.

RELATIVE EFFICIENCY AND DESIRABILITY OF VARIOUS TYPES OF ENGINES ON CENTRAL STATION LOADS.

In the paper with the above title, read by Prof. A. W. Richter, all of the various types of engines were discussed at considerable length with respect to their principles and application for electrical work. One of the factors noted as militating against the economy of engines in electrical work was the light load condition during the great portion of the time. To correct this and also to take up rapid fluctuations, the addition of a storage battery was recommended, and a case was cited where a storage battery put in a station resulted in the saving of 11 tons of coal per week and obviated an expenditure for 200-hp of generators that otherwise would have been necessary. In the Chicago Edison station about 25 per cent. of the peak of the load is carried by batteries.

In conclusion the following considerations were pointed out concerning the choice of the most economical outfit for a station: 1st. The introduction of the largest possible units in order to make the cylinder condensation, first cost per horse-power and attendance a minimum. 2d. Choice of a type of engine having the highest inherent economy that local conditions will admit. For small units and for duplicates, the vertical compound condensing direct-connected high-speed engine gives excellent results. With several engines on the same circuit it would be advantageous for all but one to be continually operated at the rated capacity. 3d. The introduction of storage batteries, thus equalizing the load upon the engine. The size of the engine can then be chosen to more nearly correspond to the average load, thus decreasing cylinder and other wastes. This with the introduction of higher pressure will make it possible to use triple or quadruple expansion engines for the larger powers. 4th. The introduction of the direct-connected system, thus reducing the transmission losses to a minimum. 5th. Great care should be exercised in the choice of auxiliaries, since an uneconomical system of auxiliaries will otherwise greatly reduce the efficiency of an economical plant.

In answer to a question as to governors for several compound engines operating on the same line shaft, Prof. Richter said that governors can be obtained now that will regulate as close as one-half of 1 per cent., which is sufficiently sensitive to make each of several engines working on the same shaft take its share of the load.

In reply to other questions it was stated to be more advisable to belt two machines from the same pulley than to use a jackshaft, and that in the case of a peak load beyond the economical output of the machine, it is advisable to raise the steam pressure to increase the economy during the time of such load. The loss from the use of a jackshaft with two machines of 150 lights, Prof. Richter said, might be 5 or 10 per cent., depending on the lining up of the shaft, upon the condition of the belts and upon their length.

A LIFE TEST OF INCANDESCENT LAMPS.

In a paper with the above title, by Prof. George D. Shepardson, an account was given of some tests conducted under Prof. Shepardson's direction by Henry Hildebrant and Arthur C. Pratt, senior students in the University of Minnesota, on the candle-power and energy consumption of a number of 16-cp incandescent lamps selected from commercial stock. The lamps originally selected represented twelve different factories, but four makes of lamps were rejected at once on account of lack of uniformity. Ten lamps of each of the remaining makes were selected for life tests, those being used which a preliminary lamp test showed came nearest to the standard rating and efficiency. All of the conditions of the test were made uniform for all the lamps. Of 55 lamps finally tested, the initial candle-power varied from 14.1 to 23 and the watts from 2.32 to 4.10 per candle. The average candle-power of the lamps of each group varied from 15.2 to 22, while the average watts varied from 2.42 to 3.60 per candle. The general average for the 55 lamps given a preliminary test was 18.3 candle-power and 3.1 watts per candle. The lamps were run on an alternating-current circuit whose voltage was maintained within a range of 2 volts.

After burning about 50 hours it was found that the candle-power varied from 8.2 to 23, while the watts varied from 2.32 to 4.10; the averages being 17.5 candle-power and 3.27 watts per candle. After 100 hours, the candle-power varied from 10.1 to 23.2, and the watts from 2.52 to 5.02 per candle; the averages were 17.5 candle-power at 3.3 watts per candle. After about 400 hours the light varied from about 11.3 to 19 and the watts 3 to 4.31 per candle; the averages were 16 candle-power and 3.54 watts per candle. After 600 hours, the light varied from 11.4 to 18.8 candle-power, and the watts from 3.24 to 4.26 per candle; the averages being 14.7 candle-power and 3.82 watts per candle. A few lamps were burning at 800 and 900 hours, after which time the light varied from 10.8 to 16.4 candle-power and the watts from 3.6 to 4.4.

Early in the test it was noted that several of the lamps were burning "blue," and these had a short life. All the lamps of this lot burned out at 100 hours, and none of those in another lasted more than 500 hours, only one of them lasting over 350 hours. These two lots were from lamps supplied to a large central station company desiring to make a change in lamps, and it was not certain whether they were high-economy lamps sent for trial or lamps intended for lower voltages but marked to suit the voltage ordered. Their performance suggests that the lamp makers find it necessary to dispose of their product by marking lamps to suit orders if there is a persistent demand for lamps of the same voltage.

A test was made to get some comparison between the behavior of lamps of constant voltage circuits and those on a circuit of poor regulation. Several lamps were placed on a circuit varying from 104 to 118 volts. The high-economy lamps died within about 300 hours, though most of their mates on a well-regulated circuit were in fair condition at 800 hours. The lamps of low initial economy taking from 3.5 to 4 watts per candle withstood the extreme variation much better. The candle-power and efficiency of the lamps on the fluctuating circuit fell in 300 hours as much as that of the lamps on constant voltage circuit in 800 hours. After the test noted had been ended, some of the lamps were placed on a photometer and the voltage raised until the candle-power equaled the initial value. Three lamps marked at 108 volts were raised to 111.4, 112.6 and 114.6, respectively, to restore them to initial candle-power. Another lamp marked for 110 volts which had burned 550 hours on a circuit with widely fluctuating voltage was raised to 120 volts before its candle-power equaled that of its youth. The efficiencies of these lamps at the higher voltage were from 1 to 8 per cent. lower than the original efficiencies. This test seems to justify the practice of moving old lamps to places on the circuit having higher average voltage.

The Status of Telephony in Sweden.

A great deal is said about the wonderful development of telephony in Sweden, but the data has never been very full or exact in regard to the development itself. Some details of an interesting nature, and apparently correct, are given in a recent issue of London *Engineering*, and are abstracted herewith. It is stated that private and local initiative has done more for this quick development than the state would have been able to in the first instance, whilst the manner in which the latter is now backing up the movement appears to be sound and practical. In the year 1880 the International Bell Telephone Company took the first steps in connection with an exchange in Stockholm, and shortly afterwards small telephone installations were started by private enterprise in some provincial towns, these being the origin of the telephone unions which give a special feature to the history of the telephone in Sweden. In a few of the larger towns limited companies were formed, but as a rule the basis was a co-operative one. The members clubbed together to supply the necessary money for central station, etc., and although the telephones were bought jointly, each member paid for his own telephone and for the installation of it. These local telephone centers grew rapidly, and connection was established between those in the same province, thus co-operative sets of centres were formed nearly all over the country. They worked admirably together, and a member could, without any special fee, converse with anybody whose line was connected with the centre. There were, however, as already mentioned, a few towns where the telephone was started by limited companies, as a commercial speculation. In Stockholm and Gothenburg it was the Bell Telephone Company, but this company had in both towns to compete with other telephone companies, of which the General Telephone Company, of Stockholm, has proved an unusually well-managed concern, extending its business to the neighborhood and other towns. An application from this company to erect telephone lines along high roads from Stockholm to other large towns was refused by the government, and this is alleged to be the only instance where the government has placed any obstacle in the way of private telephone companies.

At the beginning of the "nineties" the annual fee for smaller concerns was 50 kr. ($13.32), and for companies with larger area, 90 kr. to 120 kr. ($24 to $32). The aggregate length of the telephone wires was then about 25,000 miles, and the number of subscribers 16,000. The state commenced its operations as regards the telephone in 1883 and 1884, when it acquired a few of the larger concerns in Southern Sweden; but it was not till the telephone had attained to a much greater degree of perfection that the state began in earnest. It entered the field as an ordinary competitor, but has gradually bought the bulk of the telephone lines. The first long state telephone line (Stockholm-Gothenburg) was opened in 1889; its length was about 300 miles. Since then the state telephone has extended in all directions, the longest distance at the end of last year being Hoparando-Ystod (1250 miles).

Several efforts have been made to bring about some uniformity in fees, both as regards state and private telephones; but the question is a difficult one, the more so as most private telephones have been sold to the state on the condition that the subscribers' fees shall not exceed 50 kr. ($13.32), and this is also about the average fee with the state telephone system. In some instances a state fee as low at 10 kr. has been fixed for a series of years; whilst in others, where the state had no competition from the start, fees of about 90 kr. ($24) are charged, which, however, after five years, are reduced to one-third.

The following table shows the growth of the Swedish state telephone:

Year.	Kilometers.	Stations.	Instruments.
1890	12,780	126	4,950
1891	22,760	235	10,250
1892	29,530	334	12,560
1893	39,230	414	15,970
1894	46,830	508	19,080
1895	55,620	559	22,740
1896	62,670	633	26,910
1897	75,300	734	32,890

As a rule, there is a co-operation between the state and the private subscribers, so that the former instals the connection to the nearest existing station, builds the new central exchange and finds the apparatus, whilst the subscribers' lines and the working of the central exchange are the latter's concern. The rapid development of the state telephones—the subscribers to which have the right, subject to a modest fee, to converse all over the country—has, however, not prevented the private telephones from holding their own and partly expanding, as will appear from the following table:

Year.	Kilometers.	Stations.	Instruments.
1890	39,760	432	15,470
1891	37,840	392	14,740
1892	35,620	361	15,280
1893	36,650	404	16,640
1894	35,600	399	17,790
1895	38,650	391	19,590
1896	42,000	387	22,500

Of the private telephone companies, the Stockholm General Telephone Company stands pre-eminent; its area of operation is now confined to Stockholm and a distance outside up to 45 miles, inside which there, however, are several smaller towns. Between this company and the state telephone there is a keen competition, which has brought about an almost ideal state of things from the subscribers' point of view. Fees have been reduced in some cases almost *ad absurdum*. The annual fee of the state concern is $13.32, with an entrance fee, for business subscribers only, of another $13.32. The length of line which the state erects for this price often exceeds two miles. The Stockholm General Electric Company has a scale of fees varying according to the requirements of the subscribers; this company has, in addition to its large and splendidly appointed central station, several auxiliary centres, whilst the state telephone has only one central exchange in Stockholm. The General Telephone Company charges from 50 kr. to 100 kr. for direct connection with the main exchange, for connection with the branch stations, the fee is 35 kr. (barely $9.50) annually, subject to a fee of 10 öre (less than 3 cents) for each conversation beyond the first hundred in each quarter, to which charge there, however, are so many exceptions that it has not much practical importance. An attempt has also been made with a minimum annual charge of 10 kr. and a charge for each conversation, but this has not worked satisfactorily. Competition between the state telephone and the General Telephone Company has also reduced the charge for longer lines, so much that the charge does not in many cases cover the actual outlay.

The result is that in Stockholm almost every small tradesman and artisan, and most fairly well positioned private people, have their telephone; there are now in Stockholm and the surrounding district upwards of 30,000 places, where telephonic conversation can be carried on. Many of the smaller users mean a direct loss to both concerns, for which the company recoups itself by a number of more remunerative subscribers, and the state by more lucrative business in other parts of the country and interurban conversations.

For conversations over interurban lines there is no extra annual fee, but a fee for each conversation and these fees are, as a rule, uniform for private telephones and public stations. The fee is, for a distance not beyond 100 kilometers (62 miles) 15 öre (4 cents), for a distance up to 155 miles, 30 öre (8 cents) up to 335 miles, 50 öre (13 cents), and for longer distances 1 kr. (26 cents). These fees are for conversations of three minutes, one-third extra being charged for each extra minute. For express conversations, which are more and more used during business hours, the fee is three times the ordinary fee.

Several circumstances tended to make it possible for the state to fix low rates. In the first place, all small corporations, and some of the larger ones, find gratis premises for the state telegraphs; and, secondly, the telegraph clerks had so little work, that they were able to take over the bulk of the telephone service without incurring any extra expenditure for the state. Besides, pay is generally rather low in Sweden, more especially for women, the female telephone clerks only receiving an average of 40 kr. ($10.75) a month. The female telephone clerks are endeavoring to obtain an increase in their pay, and it is, of course, more than likely that the present low rates for telephone in Sweden may have to be somewhat raised.

The ratio of telephone instruments in Sweden is 113 per 10,000 inhabitants and 107 in the United States. In Germany it is 29 and in England 18. In Norway it is 97, in Switzerland 93, and in Canada 67. It will be seen that the telephone has reached a high state of industrial development in Sweden, but that, as usual, there are various reasons for certain facts, and that an argument applying in one country has little force in another.

Inspecting a Modern Telephone Exchange.

Another of those visiting trips for which the New York Electrical Society has made itself famous in this part of the world occurred on Wednesday, Jan. 17, when by invitation of the New York & New Jersey Telephone Company the members inspected the beautiful new building and "Main" exchange, at 81 Willoughby Street, Brooklyn. This rare opportunity was availed of by over 100 members, including some ladies, and the party was received by General Superintendent J. C. Reilly, who extended a cordial welcome to all, and who was assisted by a large staff assigned to the duty of escort. Before the inspection began, Mr. Southworth, in the absence of Mr. F. O. Runyon, electrical engineer of the company, read a brief but excellent paper descriptive of the exchange and its "common battery" system. These details will be found in the ELECTRICAL WORLD AND ENGINEER of Dec. 23, in an article that followed the opening of the new exchange. Before the meeting dispersed President Dunn in the name of the society offered its hearty thanks to the company for the privilege thus extended. The exchange was then seen in full operation, the lesser volume of traffic at night enabling the visitors to pursue their investigations most thoroughly and satisfactorily. It is needless to say that the main operating room elicited warm expressions of admiration. Seen by day, it is handsome enough, but at night, when its clusters of incandescent lamps are lit and are reflected from the rich mahogany switchboards curving around the lofty room, the picture becomes even more attractive. It was not until 10:30 that all the various departments had been visited by the successive batches of members.

CURRENT NEWS AND NOTES.

AUTOMOBILES IN ROME.—Following upon the recent introduction of electric cars, the Eternal City, in its efforts to keep abreast of "modern progress," has decided to adopt a service of automobile cabs. Although the introduction of this latest novelty has met with the same opposition as that opposed by many to the electric cars some time ago, the new vehicles are to commence running this year.

WATT-HOUR METER.—A patent was issued Jan. 16 to Paul Rissler and Heinrich Bauer, of Freudenstadt, Germany, on a watt-hour meter, in which the index of an ammeter is connected to a clock-work mechanism in such a manner that it is continuously returned to the zero mark at equal intervals of time. During this retrograde motion the index is coupled each time with a counting mechanism which totalizes the current consumed in a single throw of the ammeter index, and indicates the total sum on a dial plate.

AUTOMOBILE CABS IN PARIS.—The Paris boulevards are, according to a despatch, enlivened by the presence of a regular service of automobile cabs. The new vehicles take their place among ordinary cabs. Four are now in operation; twelve more will be ready at the end of the month, and thirty-four more before the opening of the exposition. By April the company will have sixty first class automobile carriages and fifty automobile cabs plying for hire, and the number will be increased as fast as the vehicles can be built.

MEASURING THE VELOCITY OF SOUND WAVES.—A patent was issued Jan. 16 to Walther Wolff, of Charlottenberg, Germany, on an apparatus for measuring the velocity of sound waves, and more especially the velocity of propagation of a single shock or concussion of air such as is caused by the report of a firearm or other explosions. The apparatus consists of a hollow box or receptacle closed on all sides and provided with a hole in its cover; this hole is closed by a rigid lid held down by a spring, which lid when suddenly raised by the action of the sound wave causes the interruption of an electrical current.

BOOSTERS FOR MOTOR REGULATION.—Two patents were granted Jan. 16 to Rudolph M. Hunter on the use of the so-called booster in a motor circuit for the regulation of the motor. The speed of the "booster" or regulating armature is increased or decreased by a suitable hand controller, thereby increasing or decreasing the counter e. m. f. it introduces in the motor circuit, by this means regulating the motor. The method is stated to be of value for regulation where but a single motor is used on a vehicle, though it can be applied where two or more motors are used, in which case the several motors would be permanently connected in series or in parallel.

MOTORMAN'S RECORDER.—In a patent issued Jan. 16 to James R. Cravath, a device is described providing a cheap and practical means of keeping account of the comparative amount of electrical energy used by various men operating railway motors under the same conditions. The invention consists in combining any appliance whereby the maximum rate of turning on the controller is kept within a predetermined limit, with a recording device whereby the number of revolutions the motor runs with a heavy current on its automatically recorded. When the current exceeds a certain value, a circuit is closed which contains an electromagnetic revolution counter and a contact-making arrangement on the car axle. At each revolution of the axle the current is passed through this circuit which actuates the revolution counter.

ELECTRIC METAL AMALGAMATION.—In a patent issued Jan. 16 to L. H. Barricks, an electric method is described, having for its object the increase of the activity of amalgamation of gold, silver, platinum, copper and other like metals, by keeping the mercury always in an active state. The arrangement consists of a riffle box containing a horizontal porous partition forming a bottom upon which mercury is placed. Underneath the porous plate is a chamber containing a saline solution. One electrode connects with the mercury and another with a plate at the bottom of the chamber containing the solution. The current passes from the latter electrode, through the saline solution, in the porous plate and through the mercury. The saline solution slowly seeps through the porous plate and comes directly in contact with the mercury. The current passing through the salt water to the mercury and thence to the negative electrode, will act first to decompose the salt in contact with the mercury, thus liberating sodium, which acts to purify the mercury and keep it in active condition for the amalgamation process.

PRESSURE-REGULATING APPARATUS FOR STORAGE BATTERY CIRCUITS.—Two patents were issued Jan. 16 on arrangement of apparatus for keeping constant the voltage on a supply circuit when the primary source of e. m. f. is variable—one to Mathias Pfatischer and the other to J. S. Highfield, of St. Helens, England. The Highfield apparatus consists of a motor, exciter and booster on one shaft, the motor either being independently electrically or mechanically driven. The exciter is connected in series with the field of the booster and generates an e. m. f. opposed to that impressed on the series circuit from the line, thus giving rise to a resultant excitation of the field of the booster such as to cause a constant e. m. f. on the supply circuit; that is, the booster lessens or increases the pressure of the source, so that if the motor and consequently the exciter and the booster be driven at nearly uniform speeds, the pressure of the current in the supply mains is nearly constant. The exciter at times acts as a generator and at other times as a motor, according as its voltage is less or greater than that of the source. The Pfatischer patent relates to a method of automatically regulating the field of a dynamo in order to give a constant e. m. f. A shaft continuously driven from an external source, has mounted on it two armatures. The field of one of these armatures is divided in two parts, each supplied with a shunt winding which is connected across the main circuit. These windings are so arranged as to give opposite polarities to the fields and under normal conditions balance one another. The two fields are so related that the normal current of one exceeds the limitation of the magnetic circuit of its field by an amount sufficient to permit of the desired range of fluctuation above said limit; and the normal current of the other is so much less than is sufficient to saturate the magnetic circuit of its field as to permit of the desired range of fluctuation below said limit. Therefore, variations in the voltage of the line and consequently in the shunt current supplied both of these fields, materially affect the second field, the first field remaining substantially constant. Each variation in the line circuit, therefore, gives rise to a magnetic preponderance either in favor of the second field as the voltage rises, or against that field as the voltage falls. The current generated in this armature due to the differential field influence is necessarily minute, it is not immediately applied to the movement of the regulator, but is utilized as an excitant for the fields of an auxiliary dynamo. The armature of the latter is maintained in continuous rotation, but its field is neutral save when thus excited. The current generated by this auxiliary dynamo is utilized to operate a motor which actuates the regulator.

LETTERS TO THE EDITORS.

Patent Law.

To the Editors of Electrical World and Engineer:

Sirs:—In your editorial concerning the recent decision in the case of Wood v. Bechman, you give an erroneous date for the Patent Law of March 3, 1897. This law went into effect January 1, 1898, and not July 1, 1899, as stated.

The article by Examiner Kinnan on this decision is most timely. It cannot be supposed for a moment that the decision will stand. In the language of the law, the matter decided was *coram non judice,* not before the court, the decisions of which in interference cases are limited to the question of priority. The Court of Appeals of the District of Columbia, in the case of Hisey v. Peters, 71 O. G., 892, carefully distinguished between appeals *ex parte* and in interferences. In an *ex parte* case the form of the claim may be before the court; in interferences never. The decision of the court seemed to be that the claim was unpatentable, but an appeal on this question is expressly barred by Patent Office rules, the decision in favor of patentability being final with the primary examiner.

Without expressing a final opinion, I am inclined to differ with Mr. Kinnan's conclusion that a bill in equity is the only remedy. It seems to me that under the decision in Butterworth v. Hoe, 112 U. S., 50, and similar decisions, the proper remedy is mandamus against the Commissioner. Under well known practice, the decision of the court in a matter outside of its jurisdiction binds no one, at least in those cases where the subject matter is outside of the statutory jurisdiction, and the Commissioner would be bound to issue the patent on the application of the person entitled. Of course, this may be thought an appeal from "Philip drunk" to Philip still in a state of partial intoxication, as the Supreme Court of the District of Columba, subordinate to the Court of Appeals, must be asked for the mandamus, with an appeal to the latter court. These would be practically formal proceedings, as mandamus cases against public officers always eventually reach the Supreme Court of the United States.

THOMAS J. JOHNSTON.

NEW YORK, N. Y.

Short-Circuit Curve of Alternators.

To the Editors of Electrical World and Engineer:

Sirs:—Will you permit me to make a few remarks about the abstract from some letters to the *Elektrotechnische Zeitschrift,* which you gave in the Digest of Jan. 13?

Under "Short Circuit Curve of Alternators.—Rothert," we read: "A communication in which he corrects a mistake in his article, noticed in Digest Sept. 30 and Oct. 7. Concerning the criticism of Goldschmidt, Ziehl and Behrend, he says that they have not understood his article and that the numerical examples of Behrend are entirely inappropriate. Heyland.—A communication in which he also points out that Behrend's example is inappropriate."

Now, this is not the place to restate the issue between Messrs. Rothert and Heyland on the one hand, and myself on the other, but I may be allowed to draw attention to the almost medieval controversial methods of these gentlemen. Mr. Rothert and Mr. Heyland tell us that certain gentlemen, among them myself, have utterly misunderstood their theories. And they tacitly imply that it is owing to this misapprehension on my part, that the experimental data which I have adduced in support of my criticism, strike counter to their theories. For me to assert that this misapprehension is but an "empty shadow of their own minds' throwing," would be very much beside the mark, as, of course, my testimony in a matter of so much personal interest, could not be accepted as impartial. I may console myself with the saying that, if an angry man is *probably* in the wrong, an abusive man is *certainly* so.

But it may be expected that I also have something to say in regard to the points brought forward in the letters of these gentlemen. Those who turn to the pages of the *E. T. Z.* will find—and this is not given in the Digest—that the mistake which Mr. Rothert "corrects" was actually corrected by Mr. Behn-Eschenburg and myself, and thus Mr. Rothert did not "correct," but merely "admitted," his mistake; and I may remark that, in my opinion, this admission is very much to his credit. But, if the method they attack, actually takes account of the saturation of the field magnets, what becomes of the surprising statement of Messrs. Rothert and Heyland, that the method they advocate is the only one that takes the saturation into account?

Mr. Heyland's letter contains another inaccuracy. He says that I had tested the method of Mr. Rothert and himself by experiments with an inductor generator only, while in fact the greater part of my paper was devoted to the discussion of the results obtained with a generator with revolving field and with a minimum of leakage!

The many inaccurate statements with which the letters of Messrs. Rothert and Heyland abound, constitute a remarkable, though I doubt not unintentional, misrepresentation of my paper.

ERIE, PA. B. A. BEHREND.

Parallel Operation of Direct Coupled Alternators.

To the Editors of Electrical World and Engineer:

Sirs:—The writer has read with much interest the valuable article under the above title by Mr. W. L. R. Emmet, appearing in THE ELECTRICAL WORLD AND ENGINEER of January 20, and the editorial comment thereon. There can be no question that Mr. Emmet has pointed out the true solution of a frequently baffling problem in alternating current operation; as he states, it is to the engines, rather than to the alternators, that one must look to achieve satisfacory parallel running.

In his introductory remarks, Mr. Emmet states that the principle established by him seems to be new to the literature of the subject. Without desiring in the least to enter into a controversy on this point, the writer would claim your space to point out that the matter so strongly and justly emphasized by Mr. Emmet has been taken full cognizance of in the instruction papers on Power Transmission by Alternating Currents, furnished to the students of the Electrical Engineer Institute of Correspondence Instruction. These papers were prepared by Mr. Ralph D. Mershon, the well known long-distance transmission engineer.

It will be noticed from the extract given below that, in addition to pointing out the influence of the engines on parallel operation, Mr. Mershon gives an exceedingly practical hint on the selection of engines for such work.

The following paragraphs are the ones referred to in the Institute's papers, and the writer could emphasize the fact that Mr. Mershon, in his treatment of the subject, lays far greater stress upon and gives precedence to the question of the driving engines, relegating to second place the question of identity of wave form of the alternators.

JOS. WETZLER.

NEW YORK, N. Y.

[*Requirements for Multiple Running.*—The criterion for successfur multiple operation of the generators, whether alternating or direct current, is that each generator shall at all times take its proportion of the total load and steadily carry it as though operating as an independent machine. In direct-current work the fulfilment of these conditions is comparatively easy, since the division of load is a question of adjustment of field charge. With alternators it is not so simple a matter. The load cannot be apportioned by an adjustment of field charge, and any attempt to so divide it will result in a current flowing locally between the machines, and not effective in the external circuit.

In order to understand why this is so, consider first the question of two prime movers, engines, say, coupled direct to the same shaft and having separate governors working independently of each other. What condition must be fulfilled so that a load thrown on to this shaft shall be equally divided between the two engines?

The governing devices of prime movers employing speed governors are always designed so that a slight but permanent change in speed is necessary in order that there shall be a change in the amount of power supplied to the prime mover.

Necessary Characteristics of Steam Engines for Driving Alternators in Multiple.—We will assume that each of the engines under discussion has a drooping speed characteristic; that is, when running singly it falls off in speed between no load and full load. This means that for each load upon it there will be a certain definite speed, and conversely *for each speed below no-load speed there is a certain load which the engine must be carrying in order to run at that speed.*

A thorough appreciation of the significance of the italics is neces-

sary in order to understand the problem before us. Suppose that the no-load speed of the engine is S_1 and the speed with a certain load of P horse-power is S_2, less than S_1. Then, if the engine be made to run at speed S_2, whether by means of a brake or by gearing to it another engine compels it to run at speed S_2, the governor of the engine under consideration will admit steam for a load of P horse-power, and the engine must therefore be carrying such a load.

Since the two engines coupled to the same shaft must run at the same speed, the condition for equal division of load is that the governors be adjusted that each at all times gives to its engine the amount of steam necessary to make the indicated power for the engines equal. This means that the speed curves of the engines from no load to full load shall be absolutely identical. If, therefore, we were going to purchase two engines which were to be operated as described above, our first solicitude in the matter of regulation would be not how much or how little the engines would fall off in speed between no load and full load (the usual engine-builder's guarantee), but *how nearly equal would be the indicated power of the two engines when running at exactly the same speed.*

Now, the multiple running of alternators is comparable to the case first cited, and is more nearly so if, instead of a rigid coupling between the engines, we consider them joined by a stiff spring coupling. The alternators must run at the same speed, and the power which each will deliver depends on the power supplied to it, just as in the case of the engines above, the power each delivers depends upon the steam which its governor gives it.

If one alternator receives power and the other none, the first drives the second as a synchronous motor running light, or rather as a synchronous motor carrying a small load, since the driven alternator will have to drag its prime mover along with it. If both alternators receive power, then they will divide the total load in proportion to the power each receives.]

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

REFERENCES.

Test of Alternators.—ROUIIN.—A well illustrated account of the careful tests of the alternators, installed in the plant at Cusset. The results are given in diagrams and tables.—*L'Eclairage Elec.*, Dec. 23.

Theory of Alternators.—BLONDEL.—The conclusion of his article (Digest, Dec. 9, Jan. 13). He gives a numerical example for comparing his method with those of Behn-Eschenberg and Rothert. He concludes that his theory is more satisfactory for representing the facts than former methods.—*L'Ind. Elec.*, Dec. 25.

Alternating Current Machines.—GUILBERT.—An illustrated description, taken from patent specifications, of new alternating current motors and converters.—*L'Eclairage Elec.*, Dec. 16.

Compound-Wound Polyphase Alternators.—A description of a means of making one rectifier and auxiliary feed winding respond to increased load on the several phases of two and three-phase lines.—*Amer. Elec.*, January.

Induction Motors.—MARKHILL.—A short illustrated article giving some historical notes on the development of the induction motor and explaining its action. The article contains nothing new.—*Jour. of Elec.*, November.

Designs for Small Motors.—POOLE.—Instructions and working drawings for the construction of a 1-hp four-pole motor with drum armature.—*Amer. Elec.*, January.

Transformers.—FELDMANN.—An English translation in abstract, with some of the illustrations, of the German article noticed in the Digest Nov. 26.—Lond. *Elec. Eng.*, Dec. 29.

LIGHTS AND LIGHTING.

Public Arc Lighting.—CARTER.—The conclusion of his illustrated mathematical article on the scientific principles of public lighting by arc lamps. He develops analytical and graphical methods for finding the distribution of light due to a number of arc lamps placed at given heights and in given positions, and discusses some cases of the spacing and height of the lamps, when some particulars of the distribution are specified. Usually there is plenty of light in the neighborhood of a lamp, and it is the dark space between lamps that requires attention. Here the illumination can be increased either by raising the lamps or by using such a lantern and reflector as will send out the greater part of the light only slightly below the horizontal. For the lighting of open spaces both are feasible; the second alternative being perhaps the better from a photometric point of view, since very high lamps give bad illumination of vertical objects near them. For streets, however, unless they be very wide, both are objectionable as wasting a lot of light on adjacent buildings which might have been better used, so that unless very high illumination is required, we must be content with a less uniform distribution of light than is possible in an open space. He wishes manufacturers of arc lamps would introduce the photometric curves of their lamps—running precisely under working conditions—into their catalogues; also the derived system of circles of equal illumination, together with a table giving the product of the minimum illumination due to two lamps and the square of their height, for different values of the ratio of the distance between the lamps to the height of the lamp.—Lond. *Elec. Rev.*, Dec. 29.

Low Candle-Power Incandescent Lamps.—STINE.—An article calling the attention of station managers to the large class of small consumers who would use the electric light, if the cost would not greatly exceed that of gas. One remedy is to use smaller lamps than the usual 16-cp unit and to operate them at high efficiency rather than long life. In a small hall a 4-cp lamp yields sufficient illumination. For reading purposes often 16-cp low efficiency lamps are used, giving a very yellow light. By using a nominal 8-cp lamp at 50 volts and operating it at different voltages, it requires 50 volts and 28 watts for 8 candles, 55 volts and 34 watts for 13 candles, 56 volts and 36 watts for 15.5 candles. When operated at 55 volts and yielding 13 candles of white light, it proves as effective as a nominal 16-cp lamp at 55 volts, giving yellow light, and is considerably cheaper, as 23 watt-hours are saved each hour it is in use. As a useful life of at least 300 hours may be assumed, he calculates that the saving pays for the renewal and leaves a balance. But it is possible to operate the lamp at 56 volts, thus getting the full 16-cp equivalent, the cost in this case being about 65 per cent. of the normal 16-cp lamp. He emphasizes that for such operation the filament must be well flashed and have a bright gray and polished appearance, and the exhaustion of the bulb must be thorough.—*West. Elec.*, Jan. 13.

POWER.

Niagara.—A very long description of the extensions and additions to the Niagara power system during the past year. The new 5000-hp generators, the ninth and tenth of which have just been installed, are described in so far as they differ from the original machines. Vertical sections are shown, to give an idea of the oil and cooling-water piping. A full-size drawing is also given through the armature conductors and teeth and the construction of the four-layer non-combustible edgewise field winding is shown by a working drawing. A large section of the article is devoted to the transmission apparatus for the 15,000-hp delivered to the Union Carbide Company for making calcium carbide. This power is stepped up from 2200 volts two-phase to 11,000 volts three-phase, although the distance of transmission is only 11,000 feet. At the receiving end it is stepped down in one set of transformers to 2200 volts two-phase and is again stepped down to 110 volts single-phase for use in the furnaces. The transformers, which are illustrated, are by far the largest in the world, being rated at 2500 and 2000-hp. The transformer used to supply the furnace of the Acheson Graphite Company is also de-

scribed; it delivers the largest amount of current of any single electrical machine, its maximum rated output being 37,500 amperes, which it delivers at 12 volts; the pressure can be varied from 12 to 30 volts; the recent changes in the Niagara-Buffalo transmission line and the use of reverse-current and time-element circuit breakers on this line are described. All important substations are tapped off from both of the two three-wire transmission lines in parallel with each other, and to prevent both lines being shut down in case of a short circuit upon one, reverse-current breakers are used. To prevent a short upon some minor branch in Buffalo from throwing all the breakers upon the whole transmission system, time-element breakers are used. The last section of the article describes the work of the Cataract Power & Conduit Co. which distributes Niagara power in Buffalo. This company now has 151,000 feet of 11,000-volt three-conductor cables in use as well as three substations with transformers aggregating over 8000-kw capacity. The Buffalo load is limited to 10,000-hp, owing to the lack of sufficient generating machinery at Niagara to carry all the loads offered. The article gives the load curve of the generating station for the same day during five successive years. The total load varies between 20,000 and 24,000-kw.—*Amer. Elec.*, January.

Protection of Electric Power Transmissions From Lightning.—MORRIS.—The first part of an illustrated paper read at a students' meeting of the English Institution of Civil Engineers, in which he calls attention to the necessity of disposing of the lightning flashes which actually strike the line, the induced rushes or surgings in the line, and the slow accumulation of charge in the line. In places which are not exposed to exceptionally severe thunderstorms, it is good practice to stretch an iron wire along the whole length of the overhead line, at a height of from 12 to 18 inches above the conductors and to earth this at frequent intervals along the line. The well known objects of lightning arresters are to get rid of any excessive differences of potential that may exist between the conductors and earth, and at the same time to prevent the current of the generators from following in the path of the discharge from the conductor to earth; the chief points to be aimed at in their design are rapidity of action, certainty of action, absence of moving parts, and simplicity; also that frequent inspection should be unnecessary. There are two groups: those consisting of a high resistance permanently connecting the line to earth, and those containing a short air-gap, one terminal of which is connected to line, the other to earth. Examples of the first class are the Wurts tank lightning arrester and the Wurts non-arcing railway lightning arrester, which are described and illustrated. He then begins the description of examples of the second class. The following methods are used to automatically extinguish the arc started across the air gap by the spark due to the passage of a lightning discharge: a switch controlled by an electromagnet; sudden expansion of air actuating a switch; subdivision; cooling by contact with a mass of metal; tendency of heated air to rise, combined with the action of the current in the conductor or arc; repulsion by an electromagnet; use of non-arcing metals. The arc is extinguished by a switch controlled by an electromagnet in the Garton lightning arrester which is described and illustrated.—Lond. *Elec. Rev.*, Jan. 5.

REFERENCES.

Schaffhausen.—An illustrated description of this plant which has already been referred to in the Digest.—Lond. *Elec. Eng.*, Jan. 5.

Steam Engines.—TAPP.—The first part of an illustrated article on the economical generation of steam power.—Lond. *Elec. Eng.*, Jan. 5.

SUMMERFIELD.—An article on large electric light engines.—Lond. *Elec. Eng.*, Jan. 5.

TRACTION.

Polyphase Electric Traction.—A continuation of the editorial discussion noticed in the Digest Oct. 28. A suggestion of Lieut. Smith is discussed, which is, to transmit high voltage polyphase current, to transform it by stationary step-down transformers and feed it into a low-tension working circuit consisting of two overhead wires with rail for the third side, or of one overhead wire with the rails and a third rail, and to carry synchronous converters on the train which delivers current to locomotive motors or distributed motors on the cars in multiple units. Editorially it is said that the means by which three-phase high-tension current may be taken to the locomotive is not the simple process that it may appear to be. Five other methods of control of induction motors when used for railway work, are described. First by the use of motors having a primary and secondary, wound for the same voltage, alternations and number of poles; regulation for half-speed and below is effected by connecting the primary of the first motor to the line, the secondary of the first motor to the primary of the second motor, and short circuiting the secondary of the second motor through suitable resistance; regulation from half-speed to full speed is obtained by putting the primaries of both motors to line and short circuiting their secondaries through suitable resistance; the disadvantages of this method are that the first motor is apt to be much overloaded and the controller is complicated. Second, the use of two motors wound as in the preceding case, but not operated in series, speed changes being obtained by the introduction of resistance into the secondary windings of the motors. Third, the use of motors containing primary windings of the usual forms and squirrel-cage secondaries, the changes of speed being effected by means of a variable impressed voltage. The second and third are much used for crane work, but both are inefficient at low speeds; they can be used successfully for heavy traction where long-sustained slow speed is not necessary. Fourth, the use, preferably of a single motor containing eight poles with leads brought out so as to connect the same windings for producing four poles, the secondary being of the squirrel-cage type; the complications are in the controller. Fifth, a motor or independent motors having primaries which are wound with two separate windings, one being for a complete four-pole winding and the other being for a complete and separate eight-pole winding, the secondaries being of the squirrel-cage type; variations in speed are obtained by changing from one winding to the other and also by varying the impressed voltage; the complications are within the machines, but the controller is simple.—*Jour. of Elec.*, November.

Berlin.—CARHART.—An article in which he refers briefly to the following different street car systems used in Berlin (see also Digest, Aug. 19, Sept. 30): horse cars; plain trolley system, the service of which is very satisfactory; combined trolley and conduit system with which there was no difficulty during recent snowstorms and low temperature; combined trolley and accumulator system which broke down completely during these storms. The batteries are charged while the cars are running by trolley over a distance of a mile and a half; if for any reason the line voltage is too low, the battery will not charge; such was the case in the snowstorm, in which the increased power drawn directly from the trolley caused the potential at the accumulator zone to drop to 400 volts, so that the accumulators failed to get a full charge and gave out in the middle of their run. He says that with a well designed booster system, the present plan would become very satisfactory. Berlin is said to be behind the provinces of Germany in its street car service. Germany is now passing through a period of rapid advance in the application of electric power and light. The factories of the Union Electric Company and General Electric Company of Berlin are now run entirely by motors, the latter with countershafting. But in all Germany to-day there is not over 300,000-hp of electric energy, while the fleet of the North German Lloyd Steamship Company alone is equipped with 250,000-hp of steam engines.—*West. Elec.*, Jan. 13.

Automobiles.—REYVAL.—An illustrated description of various types of Krieger automobiles. A fiacre is described in detail. The weight of the empty automobile is 1943 lbs., that of the accumulators 1005 lbs., that of driver and four passengers 792, hence whole weight 3740 lbs., 2288 lbs. upon the front axle, 1452 lbs. upon the rear. It can run without recharge over 50 miles with an average speed of 11 miles per hour. Under favorable conditions it has accomplished a run of 63 miles. There are two four-pole motors, each of 143 lbs., each giving 3-kw at 2500 revolutions per minute and 4.5-kw at 2600 revolutions. The battery consists of 44 Fulmen accumulators, weighing 1005 lbs. Nine different speeds are obtainable by series-parallel control of the two halves of the battery combined with series-parallel control of the motors; the controller connections are given in a diagram.—*L'Eclairage Elec.*, Dec. 30.

Electrically Welded Joints Between Rails and Cables.—An illustration of a method used in Buffalo. An iron block is slotted to receive the cable and is then electrically welded to the web, the copper, block, and web being thereby all welded together.—*St. R'y Jour.*, Jan. 6.

REFERENCES.

Berlin.—A description of the proposed electrical equipment of the urban railroad in Berlin, called the Stadtbahn. The three-wire system is to be used and the stations will generate 20,000-hp. There will be a number of storage battery stations at different places.—*St. R'y Jour., Int. Ed.*, Jan. 6.

Waterloo and City Electric Railway.—A well illustrated supple-

mentary description of this line, which was referred to in the Digest Dec. 9.—Lond. *Elec. Rev.*, Dec. 29.

Electric Railway Operated by Gas Engines.—A brief description of a line at Trossingen, Germany, which is 5-km long and intended for both freight and passengers. The power station contains a 100-hp gas engine, using power gas. Only two men are used at the station.—*St. R'y Jour.*, Jan. 6.

Electric Locomotive.—An illustration with a brief description of an electric locomotive built by the General Electric Company of Schenectady, for the French Thomson-Houston Company of Paris. There are four 165-hp motors. The total weight complete is 35 tons.—Lond. *Elec. Rev.*, Jan. 5.

Liverpool Tramways.—An illustrated description of the trolley lines now being installed in Liverpool.—Lond. *Elec. Eng.*, Jan. 5.

New Zealand.—A summary of the conditions of the principal tramways in that country.—*St. R'y Jour., Int. Ed.*, Jan. 6.

Sweden.—A brief account of the two short electric railways in that country.—*St. R'y Jour., Int. Ed.*, Jan. 6.

Aberdeen Tramways.—A short article on the recently opened electric trolley system in Aberdeen, England.—Lond. *Elec. Eng.*, Dec. 29.

Massachusetts.—An analysis of the annual statements of the street railway companies.—*St. R'y Jour.*, Jan. 6.

Third Rail Conductors.—DAFT.—An illustrated description of some early third rail installations.—*Cassier's Mag.*, January.

Controllers.—RICHARD.—Brief, well illustrated descriptions of recent improvements.—*L'Eclairage Elec.*, Dec. 9.

Automobiles.—KRARUP.—An article of a general nature on automobile design.—*Amer. Mach.*, Jan. 4.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Petoskey.—An illustrated description of the electric lighting plant at Petoskey, Mich., supplying current for fifty 220-volt enclosed street arc lamps, forty-six 220-volt enclosed arc lamps for interiors, and about 3000 incandescent lamps of 220 volts and 16-cp. On the day circuit there are two 25-hp, two 10-hp, one 2-hp and three ½-hp motors, besides a load of about 500 amp. in lights for basements. The original plant and the installation of the new station are described.—*West. Elec.*, Jan. 13.

Electricity in Southern Industries.—SMITH.—An article in which he says that in the south the highest standard of electrical apparatus is now called for. Slow speed motors, direct connected to the machines to be driven, are now more largely in demand. Electricity is used extensively in cotton mills, where the enclosed arc lamp has been introduced. The tendency in light and power plants is the use of larger units. Many railway and light plants have been consolidated. The development of water powers makes progress.—*Tradesman* (Chattanooga); *El'ty*, Jan. 17.

Power Plant Fire.—A report on the destruction of the Blue Lakes power plant by fire. Also an editorial discussion in which the following lessons are drawn: make power houses fireproof and provide them with fire-fighting facilities, do not concentrate all exciter, generator transformer and station wiring, instruments and devices, in a single switchboard; the vital parts of an electrical system are located in its power house.—*Jour. of Elec.*, November.

Hotel Lighting.—An illustrated description of the electric light installation of the Atlantic Hotel, in Newquay, in Cornwall. The engine house, about 200 yards away from the hotel, contains two 15-hp oil engines belted to two shunt-wound dynamos giving 17-amp. at 110 volts, or 50-amp. at 145 volts, and a battery consisting of 55 cells. The current supplies about 300 lamps ranging from 5 to 32-cp, a five-passenger lift and a pump.—Lond. *Elec. Rev.*, Dec. 29.

REFERENCES.

Bonn.—BAUER.—A reprint of the English article noticed in the Digest Jan. 20.—*El'ty*, Jan. 17.

Hotel Lighting.—An illustrated description of the electric equipment at the Hotel Metropole, in Chicago. The plant containing three direct-current generators of 60-kw, 75-kw and 90-kw capacity furnishes current for light, heat and power purposes.—Lond. *Elec. Eng.*, Dec. 29.

Lightning Arresters.—NEESEN.—The first part of French abstracts from his German book, giving short illustrated descriptions of the lightning arresters used in practice.—*L'Eclairage Elec.*, Dec. 23.

Converting Alternating Into Continuous Current.—LIEBENOW.—An illustrated abstract of the German article noticed in the Digest Dec. 23.—Lond. *Elec. Eng.*, Jan. 5.

High Tension Switch.—An illustration, with short description, of the high tension switch in use by the Power Development Company, of Bakersfield, Cal., for cutting out the secondary substations for inspection and cleaning. It is said to have proved perfectly satisfactory during the past two years. It is essentially an outdoor switch of the triple-pole, double-break type.—*Jour. of Elec.*, November.

Municipal Inspection.—An anonymous article discussing the duties and difficulties of municipal electrical inspectors, and giving practical hints for their guidance in finding faults that may be partially concealed in interior wiring.—*Amer. Elec.*, January.

WIRES, WIRING AND CONDUITS.

Methods of Suppressing Arcs in Switches, Fuses, Etc.—SCOTT.—The conclusion of his illustrated article (Digest, Jan. 6), giving short descriptions of the Fowler switch fuse, the Thomson-Houston fuse, the Ferranti oil fuse, Verity and Steele's oil fuse, the spring back fuse. He then discusses the use of non-arcing metals, the Wurts non-arcing arrester, the Mueller non-arcing switch, the use of aluminum and platinum, and mentions some suggestions which have not been put into practice. As to the proposal to do away with safety devices altogether, he remarks: "It appears that American engineers are now going further in this direction, and actually designing multiphase alternators for transmission of power work, with the sole idea of their being able to withstand short circuiting, so that when a fault occurs on the line a large current is passed sufficient to burn it out. The change is not so drastic as appears at first sight, because the writer understands it has been the practice in this city for some time to burn out any faults which may occur on the underground continuous-current cables."—Lond. *Elec.*, Dec. 22; Lond. *Elec. Rev.* and *Elec. Eng.*, Dec. 29.

Aluminum Feeders.—A description of the equipment on the Northwestern Elevated Railroad of Chicago. The feeders are 49-strand cables of 1,350,000-cm and 1,050,000-cm cross-section. They are laid in a feeder box built of pine running along the centre of the elevated structure between the tracks. The cables are laid on vitrified clay insulators spaced nine feet apart. Every twentieth set of supports consists of split-spool insulators which are clamped tight to the wire. On the curves the vitrified clay supports and the split-spool insulators alternate. At all places where the cables have to drop under switches or crossings they are dead ended and connection is made by means of insulating copper jumpers. The ends of the cables are sweated into plain cast copper connectors. Taps to the rails are made by means of clamps around the cables, not soldered.—*Amer. Elec.*, January.

REFERENCE.

Interior Wiring.—KNOX.—A continuation of the serial on this subject, taking up the construction of panel boards, giving illustrations of various forms, and discussing details such as switches, fuses, removable fuse holders, lugs for the wire contacts, snap switches, etc. —*Amer. Elec.*, January.

ELECTRO-PHYSICS AND MAGNETISM.

Calculation of Inductance of a Cable.—A description of how the total inductance in henrys of a three-wire overhead or a three-cored underground cable may be calculated for a triphase current of known frequency and amperage. The formulas give the inductance of each wire and seem comparatively simple. In conclusion it is stated that the drop in a three-cored cable conduit due to inductance is generally negligible, but in overhead lines for a high voltage when the wires are, say, 5-mm in diameter and 300 apart, the inductance drop cannot be neglected without serious error. The inductance depends on the length, diameter and distance between the wires, but not upon the amperes or the frequency. Multiplying the reactance by the current gives the drop due to the reactance.—Lond. *Elec. Eng.*, Jan. 5.

REFERENCES.

Resistance of Platinum.—RAVEAU.—A very long paper on the variation of resistance of platinum as a function of the temperature, and on the use of platinum thermometers.—*Bull. de la Soc. Int. des Elec.*, November.

Loss of Electrostatic Charges by Illumination.—KNOBLAUCH.—A long French abstract of the German Electrochemical Society paper noticed in the Digest Sept. 9.—*L'Eclairage Elec.*, Dec. 23.

Illumination of Vapors by Tesla Oscillations.—KAUFFMANN.—A very long illustrated French abstract of the German Electrochemical Society paper noticed in the Digest Sept. 2.—*L'Eclairage Elec.*, Dec. 23.

Electromagnetic Rotation.—DAILEY.—A short illustrated description of a simple instrument, suitable for lecture experiments, show-

ing the movement of a conductor through a magnetic field, when supplied with current.—*Sc. Amer.*, Jan. 20.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrochemical and Electrometallurgical Industries.—KERSHAW.—The first part of his interesting annual review for 1899. There has been a steady advancement in several of the industries and in the calcium carbide industry the growth has been so phenomenal that he thinks it has been too rapid to be sound. No new electrochemical or electrometallurgical process of any industrial importance has been introduced during 1899. The electrolytic alkali and bleach works in operation in Europe and America will shortly number 29, while ten years ago there was not a single electrolytic alkali plant in existence; the Rhodin process has made its reappearance in America; the Hargreaves-Bird process has entered upon the third and final stage of its development and an English plant is in course of erection; the process is now being operated industrially in France also; the Castner-Kellner process is developing rapidly; it is in operation in three plants and two others are in course of erection; the processes worked by the Electron Company at Griesheim and by the Bitterfeld Company at Bitterfeld—both diaphragm processes—are extending even more rapidly, both companies have been amalgamated and their processes are in use in 11 plants; the Hulin process at Clavause, in France, is said to be working satisfactorily; the Kellner process at Hallein, in Austria, is still operated on a comparatively limited scale. Six aluminum plants are in operation, two in Niagara, one each in Foyers, Neuhausen, Le Praz, Rheinfelden; 26,000-hp are available at these six plants, but it is questionable whether more than one-half of this is used at present in the production of aluminum; the increase of the output during 1899 has been due to the concentration of the manufacture at the larger works; the price of aluminum has remained fairly stationary during 1899, and it is hardly probable that any material reduction in price can occur with the present method of extraction; the price at which aluminum is being sold for conducting purposes, 29 to 30 cents per pound, is said to leave little or no profit to the producers; the only two processes in actual operation are still the Hall and Herault processes. It is claimed that the calcium carbide "boom" will be followed by an inevitable reaction, as the competition between the larger factories must cause a decisive fall of prices; the number of calcium carbide plants in operation or in course of erection has increased during 1899 from 51 to 93; this development is said to be partly due to the action of the large German electrical engineering firms, which have actively promoted the formation of carbide companies in order to benefit by the orders for generating plants. Under favorable conditions for the supply of lime and coke and with cheap power, carbide can be produced for about $40 per ton; at Meran the costs work out to $36.25 per ton, including interest and depreciation charges; in England at present the quotation is $90 per ton f. o. b. at Foyers; a great fall in prices appears therefore to be certain. With regard to the utilization of the carbide nothing of a striking nature is to be reported. In England the installation of acetylene gas makes considerable progress in country houses, and central installations for the supply of considerable areas have been installed in three places; in Germany the new illuminant is most largely used for railway station lighting, and in Southeastern Europe for lighting small towns.—Lond. *Elec. Rev.*, Jan. 5.

Aluminum in 1899.—A short article stating that in this country the production continued to be in the hands of a single company and the quantity turned out did not greatly exceed that of the preceding year, when the total was 5,200,000 lbs. Arrangements are being made for an extension of the works and a further increase of production. Prices have remained without material change during the greater part of the year, a slight reduction in quotations having been made toward the close. The selling prices in this country for No. 1 ingots, 99 per cent. pure, range from 33 to 37 cents per pound, and No. 2, 90 per cent. pure, from 31 to 34 cents, while rolled sheets held at 42 cents and upward per pound, according to quantity purchased.—*Eng. and Min. Jour.*, Jan. 13.

Hydra Dry Cell.—A description of this cell, manufactured in Germany, and recently brought into the market in France. It is a "dry cell" containing a sufficient reserve of water and hermetically closed to prevent evaporation. The hydra cell has an e. m. f. of 1.5 volts, an internal resistance of 1 ohm; until the voltage at the terminals has decreased to 1 volt, it gives 5½ amp.-hours; when the circuit was broken, the cell recovered up to 1.4-volt; by discharging down to 1 volt through a resistance of 2 ohms, 2 more amp.-hours were obtained. Nothing is said about size or weight or the chemical composition of the cell.—*L'Eclairage Elec.*, Dec. 30.

REFERENCES.

Electrolytic Refining of Auriferous Silver.—DIETZEL.—A long illustrated French abstract of the German Electrochemical Society paper noticed in the Digest Aug. 26.—*L'Eclairage Elec.*, Dec. 23.

Alloys of Iron.—TOEPPFER.—A long abstract of an account of experiments in which he investigated the electrolytic deposition of alloys of iron and similar metals, and the electrochemical behavior of these metals.—*Zeit. fuer Elektrochemie*, Dec. 22.

Aluminum.—ROBERTSON.—A reprint of the article abstracted in the Digest Jan. 20.—*Elec. Rev.*, Jan. 10.

Iron Consuming Batteries.—WATERHOUSE.—An account of using iron instead of zinc in Daniell cells. No trouble occurred through deposits of basic iron.—*Soc. Chem. Ind. Jour.*, June 1899; mentioned in *Science Abstracts*, December.

Progress of the Ozone Industry.—OTTO.—An abstract of a paper read before the Society of Civil Engineers of France on recent progress in the manufacture and the applications of ozone, and of the rather extended discussion which followed the paper.—*L'Elec.*, Dec. 23.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Resistivity of Nickel.—FLEMING.—A reprint of a Royal Society paper giving the results of what appears to have been a very careful determination for electrolytic nickel; a difficulty in former determinations seems to have been to get the nickel pure. The results are given in tables and curves covering a range of temperature from that of liquid air to nearly 100° C. The values obtained for the volume resistivity or resistance per centimeter cubed, in C. G. S. units, for the ordinary temperatures are as follows: 7641 at 18.29° C.; 8029 at 28.32; 8363 at 36.51. The curve shows that the resistances fell steadily toward absolute zero, but not quite in a straight line proportion. At 0° C. the volume resistivity is 6935 C. G. S. units; the average temperature coefficient between zero and 100° C. is 0.00618. There is an extraordinary difference between these results and those of Matthiessen which have been accepted for the past 36 years; the nickel that the latter used having nearly doubled the resistivity of that used in the present experiments.—Lond. *Elec. Rev.*, Jan. 5.

Analysis of the Higher Harmonics of Alternating Currents.—ZENNECK.—A continuation of his former researches in which he used a Braun cathode ray tube to measure the frequency of alternating currents (Digest, Sept. 16). He analyzed a quarter-phase current wave by means of a Braun tube acted upon by four coils symmetrically disposed, two being excited by one phase, the other two by the other phase of a quarter-phase system. If the current is purely sinusoidal, the curve described by the spot on the fluorescent screen is a circle; if there are higher harmonics, they trace themselves on the circumference of the circle and it only remains to count the number of maxima or minima of the radius. If there are four maxima, the secondary periodicity is five times that of the main current, as one must be added on account of the revolution. The ratio of the difference between the maximum and minimum radius vector, to the radius of the circle, is the ratio of the two amplitudes. In one case the relative periodicity was 9, and the amplitudes were 1:36.—*Wied. Ann.*, No. 12; abstracted in Lond. *Elec.*, Dec. 29.

Plotting Hysteresis Loops.—ANGSTROEM.—An illustrated abstract of a Danish paper, describing a method of using Braun's cathode ray tube (see also the abstracts of Zenneck and of Wehnelt and Donath above) to plot hysteresis loops. Two arrangements are described, one of which is the following: Four coils are arranged like a cross, the axes of the two pairs being perpendicular to each other. In the point of intersection of the two axes there is a Braun tube. One pair of opposite coils contain cores of the metal to be tested; the other pair are wound on wooden spools. The four coils are connected in series and connected to a source of alternating current. The cathode rays in the Braun tube are then deflected, the whole deflection being the resultant of the deflections due to the first and to the second pair of coils. The deflection in the direction of the axis of the first pair is proportional to the lines of force induced in the metallic cores; the deflection in the direction of the axis of the second pair is proportional to the magnetizing force. The resultant of these two deflections gives therefore a hysteresis cycle. Some curves obtained for different frequencies and different samples of iron are reproduced.—*Elec. Rev.*, Jan. 10.

Doubling the Periodicity of Alternating Currents.—ZENNECK.—A description of a method in which he uses "aluminum valves," i. e., carbon-potash-aluminum cells which only allow the current to pass from the aluminum to the carbon electrode, as has been repeatedly noticed in the Digest. The primary circuit of a transformer is split

into two branches which are wound around the core in opposite directions. Each of the branches contains an aluminum valve, but the valve is reversed in one branch with respect to the other. The effect is that one-half of the primary alternating current passes through one branch and the other through the other branch, and that as both branches are wound in opposite directions around the core, two maxima of the induced magnetic flux correspond to a maximum and minimum of the primary alternating current, so that the induced secondary current will have double the periodicity. Curves of the secondary showed such a doubling distinctly; but as his aluminum valves were imperfect, he did not obtain any very favorable curves.—*Wied. Ann.*, No. 12; abstracted in Lond. *Elec.*, Dec. 29.

Wehnelt Interrupter.—CUNNINGHAM.—A description of a form intended to avoid the breakdowns which occur where the platinum wire passes through the glass tube. For a cathode he uses a coil of lead pipe through which water is made to circulate in order to keep the liquid at any desired temperature. The platinum wire, brazed to the end of a brass wire, passes through a thick walled, closely fitting, hard rubber tube, the end of which has a lava bushing, the platinum wire fitting the hole through the lava very snugly; the size of the platinum wire is No. 6 or 8. He used this with success for some months.—*Elec. Rev.*, Jan. 3.

REFERENCES.

Vulcain Meter.—A long abstract, with some of the illustrations, of the article noticed in the Digest Dec. 23.—Lond. *Elec.*, Dec. 29.

Meters.—ARMAGNAT.—A continuation of his article (Digest, Jan. 13) giving brief illustrated descriptions of new meters, taken from patent specifications.—*L'Eclairage Elec.*, Dec. 16.

Universal Instrument for Electric Automobiles.—ALIAMET.—An illustrated description of an instrument, comprising an ampere and a voltmeter of the Weston type, to be placed in front of the driver.—*L'Elec.*, Dec. 30.

Alternating Current Measuring Instruments.—BENISCHKE.—A long illustrated abstract of a paper read before the Electrotechnical Society of Vienna, on the construction and theory of new instruments of the General Electric Company of Berlin, described in the Digest Feb. 25, 1899.—*Zeit. fuer Elek.*, Dec. 24.

Devices for Producing Large Phase Differences.—GOERNER.—An English translation, with the illustrations, of the German article abstracted in the Digest Nov. 25.—Lond. *Elec.*, Dec. 22.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telegraphs in China.—FAUVEL.—A brief abstract of an article in which he describes the development of telegraphy in China, where until 1865 neither telegraph lines nor submarine cables existed. Numerous cables were then laid, but it was not until 1884 that the first telegraphic land line was installed. In 1887 the boundaries of Siberia were reached. Now more than 230 cities are connected to the network. The tariff is high.—*La Nature*, Dec. 23.

Railway Signals.—An illustrated description of the Brierley system which has been under trial on the Great Northern Railway for about a year. It is said to have given great satisfaction. "The system is one which depends upon the movement of normally balanced levers fixed on the engine by impact with obstructions placed on the line side and gives appropriate indications on the engine itself, of the positions of the ordinary signals. The movement of the levers is made to close electrical circuits on the engine and the indications are given by the ringing of an electric bell and the appearance of discs." The details of the system are described and illustrated.—Lond. *Elec. Rev.*, Dec. 29.

Telephones in Mines.—A description of a telephone system for mining, and of the difficulties which had to be overcome. All batteries are placed on the surface. Lead covered, rubber, insulated wires were found to be the best. The main telephone at the surface was placed close alongside the winding engines, within easy reach of the driver; the surrounding noise was overcome by fitting the receivers, one at each car, with rubber cones or short funnels.—*Austral. Min. Standard*; *El'ty*, Jan. 17.

REFERENCES.

Telepantograph.—An illustrated article on a device of Greville-Williams for transmitting pictures to any distance to which an ordinary telegram can be sent. The process is said to be a mechanical one, requiring no chemical manipulations. The outside views of the transmitter and receiver are given, but they are not described. The picture to be transmitted must be written with a special ink which is a compound of gelatine and bichromate.—*El'ty*, Jan. 17.

Military Telephone.—WISSER.—An illustrated description of a combined field telephone and telegraph for military purposes, the entire outfit weighing about nine pounds. A simple switch enables one to change over from telegraphing to telephoning.—*Elec. Rev.*, Jan. 3.

Electric Clocks.—GIEHNE.—A long well illustrated French abstract of the German article noticed in the Digest Aug. 12.—*L'Eclairage Elec.*, Dec. 2.

MISCELLANEOUS.

REFERENCE.

Electric Progress.—S. P. THOMPSON.—Extracts from his presidential address to the English Institution of Electrical Engineers noticed in the Digest Dec. 16, 23.—*Elec. Rev.*, Jan. 10.

New Books.

THE "ENGINEERING" AND ELECTRIC TRACTION POCKETBOOK. By Philip Dawson. London: *Engineering*. 1056 pages, numerous illustrations.

The need of a handbook in electrical engineering comparable to that of Kent in mechanical engineering and Trautwine in civil engineering, has long been felt. It was scarcely to be expected, however, that this want should in part be first met by a comprehensive work dealing with the branch of electric traction alone; or that this branch should in itself justify a work containing over 1000 closely printed pages. The author is well known as the writer of the most comprehensive treatise in the English language on electric railways, and was thus thoroughly qualified for the enormously laborious task which he undertook in compiling the present work.

No criticism can be offered on the score of incompleteness. On the contrary, an objection that may be urged against the work is that the greater part of it relates to mechanical subjects already well covered in other handbooks or in easily accessible treatises. The sections on the steam engine, for example, partake of the character of a treatise on that subject, the matter being sufficient to fill fully 200 octavo pages. The same is true of the section on boilers which, if printed separately, would also form a treatise on the subject of about the same size. The remainder of the work, however, is confined quite closely to the special features of electric traction.

The book contains twelve sections, as follows: The Track; Overhead Line; Power Station—Generators; Power Station—Steam Boilers; Power Station—Electric Generators; Power Station—Buildings and Miscellaneous; Storage Batteries; Surface and Conduit Systems; Rolling Stock and Motors; Testing and Testing Instruments. Though of English origin, the work may be said to be written with respect to American practice, of which the author several years ago made an extended study, giving the result in a long series of articles published in London *Engineering*.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, New York. Meeting, Jan. 24. Papers: "Notes on Single-phase Induction Motors and the Self-starting Condenser Motor," by C. P. Steinmetz, and "A New Method of Tracing Alternating Current Curves," by Fitzhugh Townsend.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Kansas City, Mo., October, 1900.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, Chicago, May.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, July, 1900.

INDIANA ELECTRICAL ENGINEERING SOCIETY. Next meeting, Purdue University, Lafayette, Ind., Feb. 1-3, 1900.

The New York Cycle and Automobile Show.

An evening or two can be most interestingly and usefully spent this week, by anybody in New York, at the Cycle and Automobile Show at Madison Square Garden. There may not be quite the old furore about it that marked the annual show when the bicycle was in its first boom, but while the bicycle exhibits are now of a standard of excellence not reached in those earlier days, the automobile has come in to advance a new art on kindred lines. Hence also the attendance while large is of fine quality, the number of well-to-do people being very noticeable, especially in the vicinity of the automobile spaces. Moreover all the automobile concerns feel rewarded for their

efforts, the orders and inquiries from people who mean business, being numerous, although prices have been advanced all round.

GENERAL ELECTRIC AUTOMOBILE COMPANY, of Philadelphia, whose vehicles were recently described in these columns, have an electric break of handsome build in their space, and distribute literature.

FOSTER & CO., of Rochester, N. Y., have two electric automobiles the main feature of novelty in which seem to be the reversion to the old use of the sprocket and chain for connection between the motor and the driving axle, the motor being thus brought close up under the body of the buggy. The weights of the vehicles shown is stated to be 1000 pounds, and the time of charging 45 minutes at a cost of 40 cents, with 75 to 100 miles on one charge.

AUTOMOBILE FORECARRIAGE COMPANY have an interesting exhibit of a gasolene attachable and detachable motor truck to be applied to any existing vehicle. Electric motor forecarriages are being built on the same lines. This forecarriage can be put on or taken off in about an hour. One of those prominently identified with the company and the exhibit is Mr. Wm. Hazelton, 3d, well known to old-time electric railway men.

THE COLUMBIA BICYCLE is as usual to the fore, in the time-honored space, but none of the automobiles are shown that the name is now associated with so prominently. In one corner of the big space is the wonderfully ingenious Rice gear cutter at work driven by an Eddy motor. In principle it is a profiling machine, and the manner in which the work is done of producing exact reduced copies of the master gear is most admirable. The linear ratio between master gear and bicycle gear made is five to one.

THE AMERICAN ELECTRIC VEHICLE COMPANY were represented by Messrs. Corrigan and Osborne, and a large staff, and had three of their vehicles built in the west, their new eastern shops being now got ready for production. The exhibit included their runabout, their break and their delivery wagon, while the catalogue and price list distributed gave prices as to a number of other new varieties including their striking American brougham, "1900 type," which will sell for $3500, with speeds up to 12 miles an hour, 5-hp motor, a weight of 3000 pounds and the driver's seat in the rear, as in a hansom, with steering rod over the roof to the front axle, and batteries in a detachable box under the body.

THE EDDY ELECTRIC MANUFACTURING COMPANY have a very neat and effective exhibit on the main aisle. In one corner they show their running gear complete, for omnibuses, No. 12 style with a 2 6-10-hp motor capable of working up to 9-hp. They show also three other styles of automobile motors with square and round frames, and a notable new controller of most positive action. They are also shrewd enough, in view of the amount of plating done in the cycle art, to show one of their solid No. 4 six-pole double voltage plating machines. Appropriate literature is distributed, and the exhibit is in the highly competent care of Mr. O. T. Smith, from the Windsor factory, and Mr. H. B. Coho, of New York.

THE INDIANA BICYCLE COMPANY have a fine and effective exhibit of their automobiles which were first seen in the east at the Electrical Exhibition last May. The exhibit, as then, is in charge of Messrs. L. S. Dow, secretary; R. H. Hassler, electrical engineer, and F. M. Hoblett. These vehicles are all pretty closely standardized, having as a general thing a 2-hp motor and 44 cells, the cells varying in size with the work. The exhibit includes a runabout, 30-mile radius; Stanhope, mail phaeton, small break for four passengers, Newport break; dos-a-dos and delivery wagons in two styles. The Waverley delivery wagon has the feature of a removable top for which an extra seat can be substituted. The smaller wagon has a goods capacity of 600 pounds, and the larger one will carry as much as 1000 pounds.

RIKER ELECTRIC VEHICLE COMPANY have the most conspicuous display in the automobile line, and one which in these days of combination, etc., is the more conspicuous as being due to the genius of one man, and he still a young engineer. The exhibit is in charge of Messrs. A. L. Riker, Mr. Whiting and others of their staff, and President F. S. Stevens and Mr. C. A. Lieb are also in frequent attendance. The vehicles shown are in the right hand space at the entrance to the Garden, and comprise their phaeton, runabout, surrey, dos-a-dos, demi-coach, theatre bus, soda water delivery wagon, and a new type of delivery wagon with wooden wheels and double motors of 2-kw each and 44 cells of 90 ampere hours, other types of Riker delivery wagons having one motor only. In addition to the exhibit the company have two catalogues for distribution, one of them being just from the press and very handsome, showing several Riker types that could not be crowded into the space.

Double-Current Generators.

ELECTRICAL engineering as applied to street railway work is slowly but surely introducing polyphase apparatus. Since the initiation of street railways, direct current has been the motive power chiefly employed, but on account of the difficulty of transmitting it, the length of lines has been limited. The latest designs for electric railways have introduced alternating current apparatus at the generating station, which is transmitted, and converted at substations to direct current. By this means it is possible to operate from a central power station systems of over 100 miles in length.

Double-current generators are another method of introducing alternating current into street railway power stations, and several Westinghouse machines recently constructed for this purpose are illustrated in the accompanying engravings. One of 600-kw for the Quebec, Montmorency & Charlevoix Railway, is direct connected to a water wheel, receiving power from the Montmorency Falls, and works at a speed of 286 r. p. m. This generator, two views of which are shown in Figs. 1 and 2, has 28 poles, and delivers direct current at 550 volts, and two-phase alternating currents at 8000 alternations and about 400 volts. It will carry its full rated load on either end, or it will divide the load of direct and alternating current in any proportion that may be required. The direct current is fed into the railway lines adjacent to the station and the alternating current is transmitted at a high voltage to a distant substation.

Two other similarly constructed double-current generators are in operation at the power house of the Philadelphia & West Chester Traction Company. These two machines, each of 400-kw, have 20 poles, and at 115 r. p. m. deliver direct current at 550 volts, and three-phase alternating currents at 340 volts. These generators are of "engine-type," the rotating part being built upon a cast spider, and the external frame divided in a vertical plane to allow access to the windings. The armature has a direct-current winding for a normal output of 757 amperes at 550 volts. The alternating end is connected for operation on a three-phase circuit at approximately 680 amperes per terminal at 340 volts. The field has a shunt and a series winding, the shunt being arranged for separate excitation at 500 volts and 20 amperes. The series winding is such that if the machine be operated as a direct-current generator at constant speed, the e. m. f. will rise from 500 volts no load to 550 volts full load. The alternating-current end is regulated by hand.

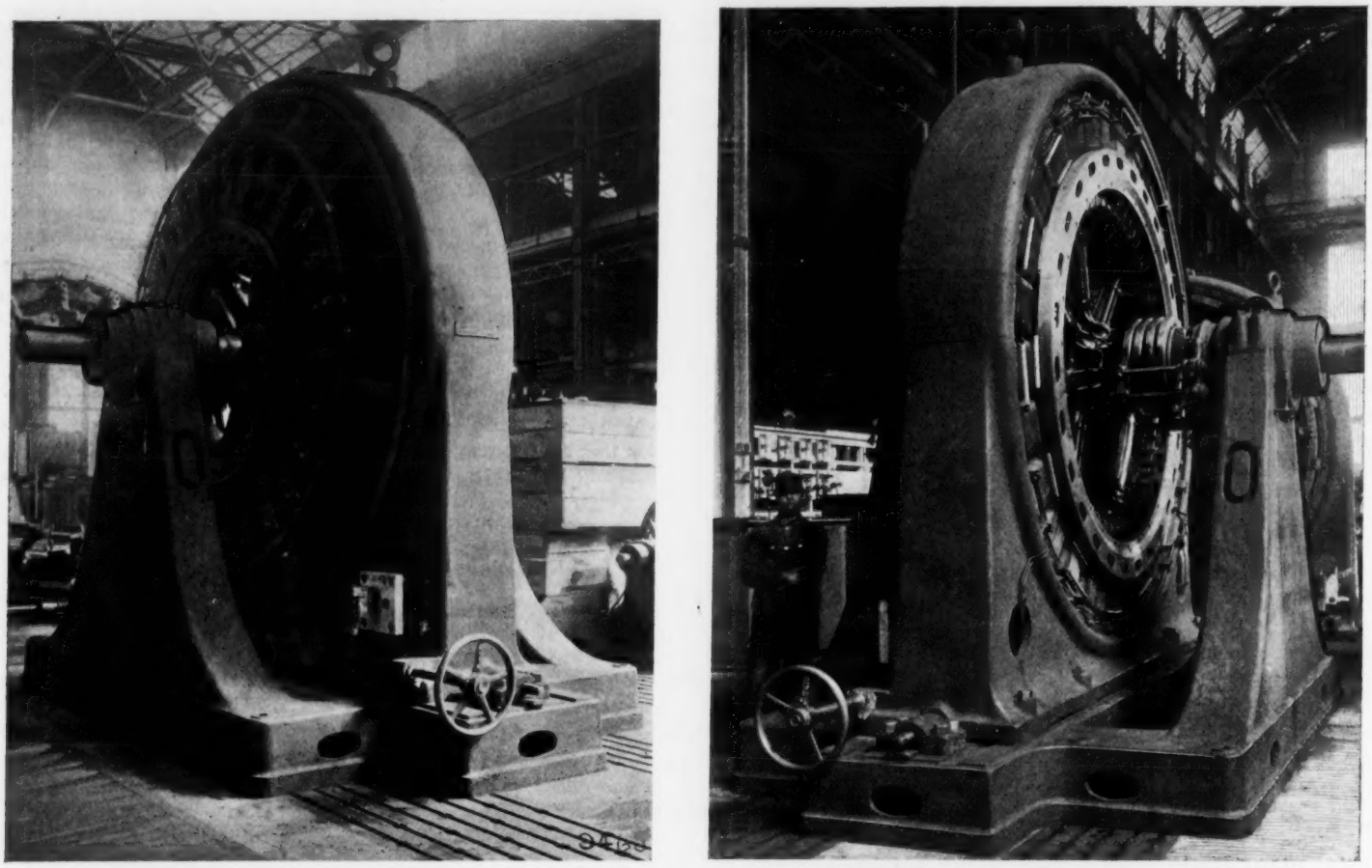
As regards commutation, the brushes having once been properly adjusted there is practically no sparking due to variations of load within the limits of no load and 50 per cent. over load. The machine will run at full load for twenty-four hours with practically no sparking, and with a temporary over load of 75 per cent. no sparking will occur. The field frame is made of the best quality of cast iron. The pole pieces are of laminated steel, the poles and field winding being proportioned so as to reduce the armature reaction and self-induction to a low limit. The shunt field coils are wire wound and the series field coils strap wound.

The armature is of the "slotted drum" type. The core is built up of laminated steel of high magnetic quality, the laminations being pressed upon the cast-iron spider, and the sheets of steel dovetailed accurately to the spider, the laminated core thus built being held firmly between two end plates. The armature winding consists of strap-wound coils, formed and insulated before being placed in the slots, and held in the slots by retaining wedges of hard fibre.

The number of bars of the commutator is such that with the e. m. f. of 550 volts on the machine, the average difference of potential between two bars does not exceed 16 volts. The commutator bars are held in position at one end by a cast iron ring with a "V" section. The other ends of the commutator bars are supported by segments of a similar section, firmly held in position by bolts. The armature winding is thoroughly soldered to the necks of the commutator bars. The brushes are of carbon, the brush holder being of the sliding-shunt type.

One of the six 1000-kw Westinghouse rotary converters supplied to the Third Avenue Railroad, of New York, is shown in Fig. 3. These are capable of being used as double-current generators, and in fact four of them now installed in the Sixty-fifth Street station are performing double service. They are rope-driven from horizontal steam engines, direct current being taken from the commutators at 550 volts for feeding the railway circuits, and from the collector rings are taken alternating currents at approximately 340 volts which is raised by means of step-up transformers and transmitted to

the 129th Street station to operate a similar machine now used as a 1000-kw Westinghouse rotary converter. A view of one of these machines arranged as a rotary is shown in Fig. 3. The armature in Fig. 4 has the shaft extended for use upon a double-current generator.



Figs. 1 and 2.—600-kw Double-Current Generator.

These machines, which are the largest rotary converters yet constructed, have 10 poles and operate at 300 r. p. m. They have large overload capacities, so that when working under full load continuously there is a very slight rise in temperature. The frames are arranged so that they can be changed from double-current generators to rotary converters whenever desired. This can be done by cutting off the shaft, and by the addition of a starting motor. The rotating part of the starting motor is pressed upon the armature shaft of the rotary.

Several other electric railway companies have installed Westinghouse double-current generators, among them the Lewiston, Brunswick & Bath Railway, and the Metropolitan Railway Company, of Toronto, Canada. It is evidently advantageous for railway com-

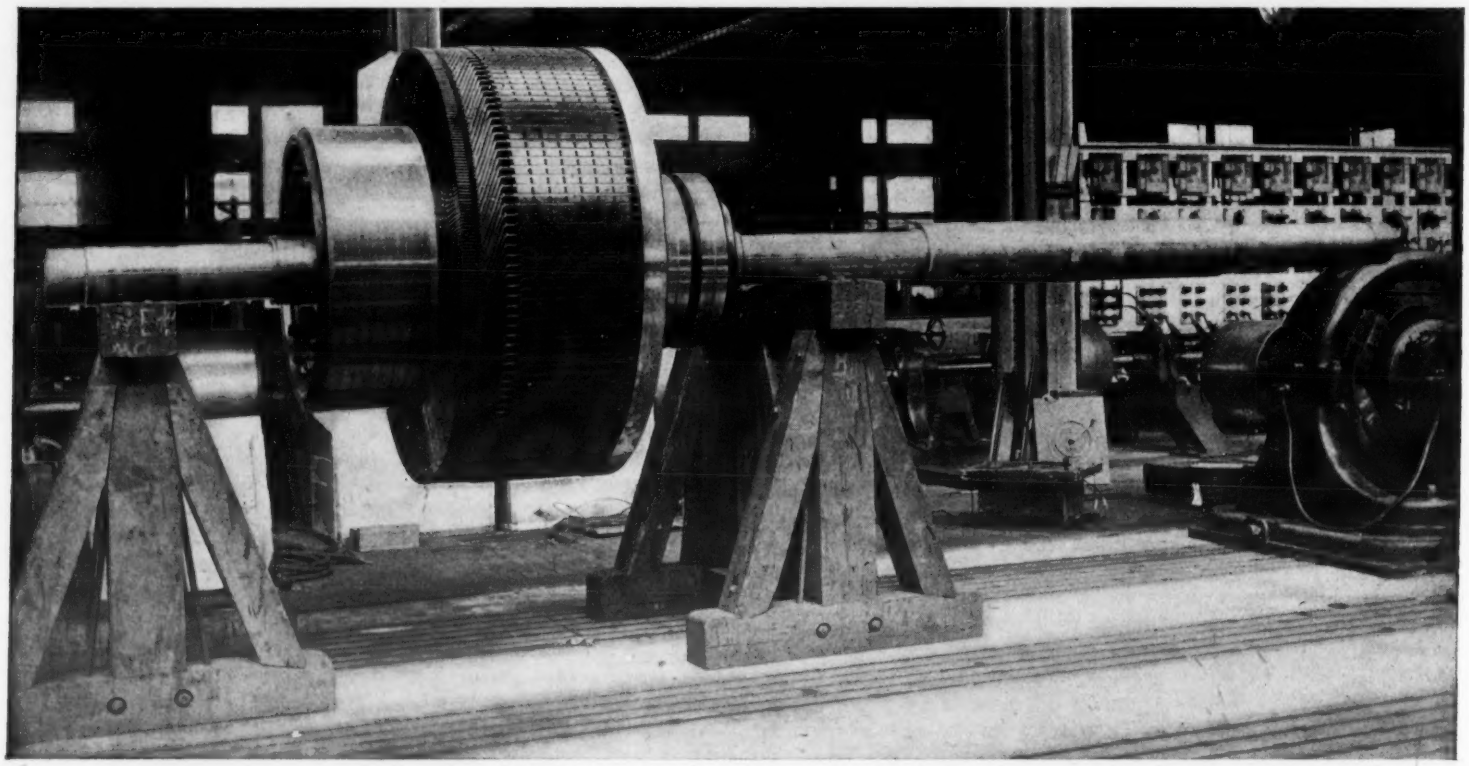


Fig. 4.—Armature of 1000-kw Double-Current Generator.

panies to be able to supply the distant parts of a long system, and the line adjacent to the power house, from the same generator, and it is more especially so where only a few cars are operated. To gain the best results with this type of machine it is necessary that they be operated at a high speed, to avoid a multiplicity of poles. For this reason they are especially well adapted for direct connection to water wheels.

There is little doubt that double-current generators will become popular for central station work wherever both direct and alternating current have to be supplied, as much electrical machinery may be abolished by their use, and the loss of power consequent upon the use of such machinery obviated. For instance, if the station generates alternating current only, at a high voltage, the conversion to direct current necessitates transformers and rotary converters. Or if direct current only be generated, a rotary would be necessary for conversion into alternating current; and if all current from the generators is at a low voltage, direct for the three-wire system, then for conversion to alternating current at a high voltage for use at a distance necessitates rotary converters and transformers. Not only therefore does the use of double-current generators greatly simplify and reduce the amount of electrical machinery in a station, but they reduce the loss of power consequent upon efficiency losses.

The greater flexibility afforded to a station by the use of double-current generators cannot fail to bring them into very general use for

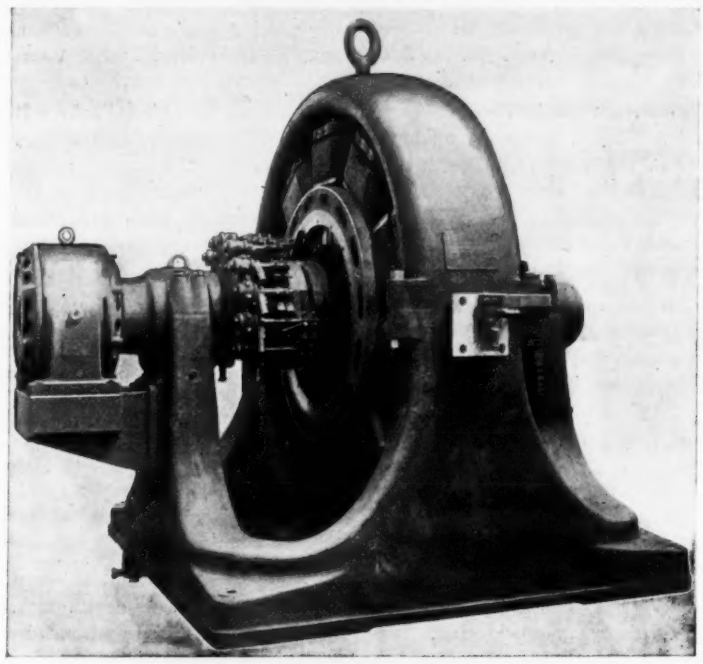


FIG. 3.—1000-KW ROTARY CONVERTER, USED AS DOUBLE-CURRENT GENERATOR.

both railway and lighting service, or the two combined. Since they are able to deliver their regular output as either direct or alternating current, or a part of each at a low voltage, the direct current is at once available for use on the three-wire system without passing through any anxiliary machinery, and the alternating current, although not suitable for service at a distance on account of its low voltage, can be raised by transformers. There is a definite ratio between the voltages upon the direct and alternating current ends of the same machine. The usual calculation for two-phase currents is .71 of the direct current voltage and for three-phase currents .62. This definite ratio limits somewhat the use of double-current generators, and makes necessary the use of raising transformers in most cases.

Storage batteries may be very advantageously used in connection with double-current generators, either to increase direct-current capacity at times of maximum load, or to supply the entire output of both direct and alternating current at times of minimum load, and to regulate the station pressures for both the direct and alternating current at any load. The battery operating in multiple with the direct current windings, tends to maintain the direct-current pressure in the usual way, and also to maintain the pressure in the alternating current coils, because any momentary increase in the load of these coils tending to slow up the armature and react on the magnetic field, lowers through the same means, the pressure, and consequently the current in the direct coils, thus reducing the total armature reaction and the engine load.

The Oldest Enclosed Fuse.

The present discussion by the Board of Fire Underwriters about enclosed fuses, calls attention to what is probably the oldest as well as the most widely used fusing device utilizing the enclosed fuse principle—the Edison plug cutout. This device has now been in constant demand for almost twenty years wherever 110 and 125-volt circuits are installed.

In 1881 the first cutouts of this type were constructed and used in all of the early installations of the Edison lighting systems, notably the large lighting plants in New York, Boston and Milan. The fuse plug was patented in the following year in its original form, but in 1885 a number of improvements were added, and as then patented its external appearance was substantially that which has been used ever since.

FIG. 1.—EDISON FUSE PLUG MADE IN 1881.

FIG. 2.—EDISON FUSE PLUG IN 1900.

The body of the plug was first made of wood with a suitable enclosure for the fuse; later it was made of glass with metal screw cap. It has, however, from the first embodied the convenient screw feature which has distinguished the Edison base lamps for so many years.

In 1896 these fuse plugs were still further improved, the glass body being changed to porcelain and its internal construction modified to permit the use of a longer fuse, which passes over a barrier and secures much greater reliability.

During the early introduction of electric lighting, hundreds of thousands of these cutouts were shipped to all parts of the world, many large systems being fully equipped with them.

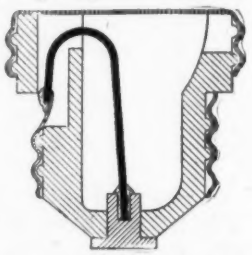


FIG. 3.—SECTIONAL VIEW EDISON FUSE PLUG MANUFACTURED IN 1900, FUSE EXTENDING OVER BARRIER.

The introduction of electricity into houses was at first regarded with considerable apprehension by tenants and property owners, hence the simplicity of the screw plug fuse appealed at once to every one interested. By its means a man entirely ignorant of electricity or mechanics could renew a fuse without any danger either to the circuit or himself, and when the fuse melted no sparks escaped from the plug to endanger surrounding objects.

Probably no other device at present used in electric installations has for so many years adequately fulfilled the purpose for which it was originally designed, with but slight modifications. In its present form, as patented in 1896, it is without doubt the most popular and most generally approved device for protecting 125-volt circuits.

Exhibits at the Convention of the Northwestern Electrical Association.

Following is a record of the exhibits of electrical apparatus, etc., made in connection with the meeting of the Northwestern Electrical Association at the Hotel Pfister, Milwaukee, on January 17 and 18, together with notes of a personal character. A report of the convention proceedings will be found on page 132 of this issue.

R. LESTER THAYER, of Peoria, Ill., visited the convention and met many friends.

MESSRS. CUTLER & HAMMER were most ably represented by Messrs. Hickcox and Bacon.

THE CROCKER-WHEELER COMPANY, of New York, was well represented by Mr. Julian Roe.

THE LESCHEN-MACOMBER-WHYTE COMPANY, Chicago, was represented by Mr. George Whyte.

THE NEW YORK INSULATED WIRE COMPANY was represented by Mr. James Wolff, of Chicago.

THE TWENTIETH CENTURY LAMP COMPANY, of Chicago, was represented by Mr. Frank P. McGraw.

THE AMERICAN STEEL & WIRE COMPANY was represented by Mr. Channing T. Gage, of St. Paul, Minn.

MR. T. F. WHITEFIELD represented the Northern Electrical Manufacturing Company, of Madison, Wis.

THE JOHN A. ROEBLING'S SONS COMPANY'S interests were looked after by Mr. A. B. Conover, Jr., of Chicago.

MR. A. F. HAMACEK, of Sturgeon Bay, Wis., was on hand, representing a line of alternating arc lamps.

MR. GEORGE CUTTER, president of the George Cutter Company, Chicago, was in attendance at the convention.

THE CORNELL MACHINE COMPANY sent a representative in the person of Mr. W. Wood, its well known general manager.

THE PERU ELECTRIC MANUFACTURING COMPANY, Peru, Ind., was represented by Mr. R. H. Bouslog, secretary and treasurer.

THE DEARBORN DRUG & CHEMICAL COMPANY, of Chicago, was represented by President William H. Edgar and Mr. J. M. Frye.

THE WESTERN ELECTRIC COMPANY, of Chicago, placed its interests in the hands of its well known general sales manager, Mr. Tucker.

MR. R. E. LUCAS, general manager of the Indiana Insulated Wire Company, of Jonesboro, Ind., was extended a hearty welcome by his many friends.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, of Pittsburg, Pa., was well and ably represented by Messrs. Pinckard and Burton.

THE FORT WAYNE ELECTRIC WORKS' interests were well taken care of by Messrs. Frank McMasters and W. C. Knight, both well known in the electrical field.

THE THOMAS BELTING COMPANY, Chicago, placed its interests in charge of Mr. J. M. Thomas, president, and G. O. Thomas, secretary and treasurer.

THE CHICAGO GENERAL FIXTURE COMPANY, Chicago, had its interests well taken care of by its president, Mr. Franklin Overbaugh, and Mr. V. C. Grace.

THE ILLINOIS INSULATED WIRE COMPANY, Sycamore, Ill., was represented by Mr. Fred H. Alden, president, and Mr. J. Geiserowich, secretary and treasurer.

THE NEW YORK & OHIO COMPANY, of Warren, O., was personified in Mr. W. D. Packard, secretary and treasurer, whose many friends were glad to meet him.

THE SPEER CARBON COMPANY, St. Marys, Pa., through Mr. John S. Speer, its popular general manager, brought the merits of its goods to the attention of the delegates.

THE ILLINOIS ELECTRIC COMPANY sent Messrs. L. K. Cushing, secretary, and Harry Adams, C. W. Bacon and D. Newman to represent it, which they did in a befitting manner.

THE CROUSE-HINDS ELECTRIC COMPANY exhibited a line of fine knife switches, switchboards and panel boards, being represented by John W. Brooks, western manager, Chicago.

THE SANGAMO ELECTRIC COMPANY, of Springfield, Ill., exhibited the "Guttman" reocrding wattmeter. The company was represented by President J. Bunn and Mr. R. C. Lamphier.

MR. M. B. WHEELER, secretary and treasurer of the M. B. Wheeler Electric Company, of Grand Rapids, Mich., attended the convention, and. from all appearances, secured a lot of business.

STENZ, WEYER & COMPANY, of 125 Indiana Street, Chicago, exhibited in Parlor 2 a first-class line of shadowless arc light globes, the many advantages of which they impressed upon the visitors.

THE BUCKEYE ELECTRIC COMPANY and the Jandus Electric Company, of Cleveland, were represented by their Western manager, Mr. Joseph H. Cooke, who was heartily welcomed by his many friends.

MR. GEORGE SEARING, an old time convention favorite, lost no time in telling his many visitors that the Hart & Hegeman Manufacturing Company manufactured the finest line of switches on the market.

THE WAGNER ELECTRIC COMPANY, St. Louis, Mo., had its headquarters in Parlor 3, and its interests were well looked after by Messrs. E. H. Abadie, general sales manager, and George Foster, of the Chicago office.

THE GREGORY ELECTRIC COMPANY, Chicago, were represented by Mr. A. O. Kuehmsted, and their well known and old time favorite, Mr. R. H. Watson. This company entertained very hospitably in Parlor 4, and, from appearances, were influencing much business.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, represented by their popular president, Mr. W. W. Lowe, S. A. Rall, W. P. Upham and B. B. Downes, occupied parlor 17. These gentlemen were kept busy at all hours explaining the advantages of their products.

THE BANQUET at the Hotel Pfister was a decided success, the pleasantest feature of the evening being the singing of the Arlington Quartette, of Milwaukee, which was engaged for the occasion by the Illinois Electric Company. These four young men sang to the delight of every one present. The programme would indeed have been incomplete without them.

THE BRYAN-MARSH COMPANY, in Parlor 12, exhibited their new portable photometer, which attracted much attention and was highly spoken of by every observer. It is made by the Bryan-Marsh Company in their own shops. This company was represented by its president, Mr. C. D. Marsh, and Mr. Guy V. Williams, manager of the Northwestern District Office, with headquarters at Minneapolis.

THE M. B. AUSTIN COMPANY, Chicago, occupied Parlor 5, and had a very fine line of Safety wires and cables, K. K. weatherproof wire, Chase junction and outlet boxes and Edison circuit breakers. Mr. M. B. Austin, president of the company, was kept busy explaining the merits of his goods to the members of the convention, as were also Messrs. W. A. Brown and A. H. Friend of this company.

THE SIEMENS & HALSKE ELECTRIC COMPANY occupied Parlors B and 6. They, however, made no exhibit of machinery other than that of the improved Duncan meter. The company was well represented in the persons of Messrs. C. E. Wilson, Thomas Duncan, W. G. DeCelle and E. F. Kirkpatrick. The Siemens & Halske Electric Company are doing an enormous business, not only in street railway apparatus, but in alternating current machinery.

THE MARTIN J. INSULL COMPANY, of Chicago, occupied Parlor 8, and had one of the most complete exhibits shown at the convention. This company is the Western sales agent for the General Incandescent Arc Light Company, and had on exhibition a sample of their "G. I." new type alternating lamp. In operation it was noiseless, which point was most favorably commented upon by the visitors. The "G. I." direct connected lamps were also shown; also Wright Discount Meters and Paragon "1900" type fan motors, "G. I." knife switches, Ferguson fuses and other products of the "G. I." factory.

THE GENERAL INCANDESCENT LAMP COMPANY showed the latest improved apparatus for manufacturing modern incandescent lamps. All filaments used in these lamps are manufactured by the company. The flashing process is controlled by automatic apparatus, which insures uniformity of candle power, voltage and wattage. The lamps are exhausted individually, which insures a perfect vacuum. The company also exhibited "D. & W." enclosed fuses, Chapman voltage regulators, Emerson's alternating fan motors and Jenney generators and motors. The company was represented by Mr. G. E. Johnson, secretary and treasurer, and Mr. W. E. Pimlott, of the Chicago office; Mr. Thomas James, Milwaukee office; Mr. L. A. Cass, Minneapolis office, and Mr. Francis Raymond, of the St. Louis office.

THE GENERAL ELECTRIC COMPANY held forth in Parlor 9, and was represented by the following named gentlemen: F. N. Boyer, manager supply department; J. Scribner, manager lighting department; Mr. R. Fleming, of the arc lamp department, Lynn; Tom Ferris, the Milwaukee representative; W. J. Ferris and Mr. R. S. Swain, of the Chicago office, and I. R. Prentiss, of Schenectady. This company had a working installation showing the operation and general arrangement of its constant-current series alternating system of arc lighting, and consisting of a five-light transformer and equipment of enclosed lamps. It attracted much attention from the members of the convention. There were also on exhibition samples of various other types of lamps, including the latest form of enclosed lamp for alternating-multiple circuits, as well as some samples of the series-direct-current enclosed lamp for use on ordinary direct-current arc circuits, for 6.6 and 5 ampere service. All these lamps represent the latest development in this class of apparatus, and considerable interest was manifested in their operation.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET was generally dull and inactive, but prices were up rather than down, and on the whole the reasons for advance or firmness predominated over those for weakness and decline. Money has been much easier and seems to be accumulating at the financial centres. During the week Western Union was dealt in to the extent of only 1152 shares, rising ¼ to 87¼. General Electric was steady around 123 on sales of only 920 shares. Brooklyn Rapid Transit was up 1⅞ to 70⅝ on dealings in 133,000 shares. On sales of 37,547 shares, Metropolitan Street Railway was off 1¼ to 164½, and Manhattan Elevated declined ⅞ to 93⅛ on 38,180 shares. The biggest traction decline was in Third Avenue, which, on reports of raising funds to cover some $16,000,000 of floating debt, declined 7 points to 112 on 27,535 shares. In Chicago, the closing quotations were: Metropolitan Elevated preferred, 76-77; Lake Street Elevated, 12; West Chicago Railway, 110; Union Traction preferred, 74½; Consolidated Traction, 40; Lake Street Elevated debentures, 91, income 5s, 32½-35; West Chicago Railway consolidated 5s, 103¼; Metropolitan Elevated 4s, 95⅜. In Boston, American Bell Telephone closed the week at 327-330; Erie, 103½-104; Westinghouse Electric preferred, 60-63; Boston Elevated, 95½-96½; West End, 92-93. In Philadelphia, closing prices were: American Railway Company, 5-5⅛; Electric Storage Battery common, 80-82, preferred, 79-83; Philadelphia Traction, 96¼-96½; Union Traction, 37¾-37⅜; Pittsburg Traction, 28½; Consolidated Traction of New Jersey, 61-63. In the New York outside market closing prices were: Electric Axle Light & Power, 4-4½; Electric Boat common, 18-20, preferred, 30-35; Electric Vehicle common, 45, preferred, 85; New York Electric Vehicle Transportation, 10-11; New England Electric Vehicle Transportation, 6-7; Illinois Electric Vehicle Transportation, 2½-3; Otis Elevator common, 20-25, preferred, 86-89.

CONSOLIDATED GAS.—The election of William C. Whitney, Thomas F. Ryan and Anthony N. Brady this week as directors of the Consolidated Gas Company of New York, at that company's annual meeting, is looked upon as very significant in its bearing upon the local traction situation, and the likelihood of the passing to one general ownership of all the existing local traction systems. It would appear to be but another step in a combination to be effected between the Metropolitan and Third Avenue Companies. The Manhattan Elevated Railway Company is already allied by transfer arrangements with the Third Avenue Company and would naturally find a place in any general combination of traction systems. By gaining control of the electrical light, heat and power business of this city the Standard Oil interests, already controlling the Consolidated Gas Company and owning interests in the New Amsterdam and Standard Gaslight Companies, with the ultimate control of the two last mentioned companies apparently in sight, will be able to light the city as the city chooses to be lighted, either with electricity or gas; would be able to furnish heat in the shape of fuel gas, and will also be in a position to supply all the electricity needed to operate the traction lines of the metropolis. The Standard Oil interests own the Brooklyn Union Gas Company, while Anthony N. Brady is president of the Kings County Electric Light & Power Company, which controls the electrical business of the borough of Brooklyn. A further extension of the general harmonization of interests would also have to consider the taking in of the multitude of traction lines included in the Brooklyn Rapid Transit Company's great system.

ILLINOIS ELECTRIC VEHICLE.—An official announcement to be presented to the stockholders of the Illinois Electric Vehicle Transportation Company shortly will probably advise reduction in the amount of the capital stock from $25,000,000 down to $5,000,000. The Illinois Company shares are of $100 face value, of which $5 has been paid, and they are subject to call for installments in the future, as the needs of the company may require. Thus, while the reduction in the capital would leave the stockholder's interest in the present assets of the company unchanged, it would reduce his liability on calls for future payments under the underwriting agreement. The amount of cash secured from payment of the first $5 installment on the shares yet remaining in the treasury of the company is equal to more than the present market price of the shares, and no doubt it is the present liability of the stockholders for future payments which has depressed the value of the company's securities on the market. The company is actively getting into shape for a large development of its business.

THIRD AVENUE DEBT.—A syndicate of bankers has agreed to take care of the $17,000,000 floating debt of the Third Avenue Railroad Company. Although not officially stated, it is understood that Kuhn, Loeb & Co. will be the managers of the syndicate. The agreement reached is simply to advance the money necessary for the completion of the construction work now in progress. Ultimately the unissued, but authorized, capital stock, amounting to $24,000,000, will be underwritten, and in that way the entire floating debt will be wiped out and the company placed upon its feet. Under the most favorable aspect the affairs of the company can hardly be called flourishing. In the official report for the quarter ending September 30, 1899, the floating debt was stated to be $16,240,122. The stock has dropped in a comparatively short period from 240 to about 110.

BIG TELEPHONE CAPITAL.—A special despatch from Trenton of Jan. 23 says: "The Excelsior Telephone, Telegraph & Subway Company to-day filed articles of incorporation here. The capital is stated to be $5,000,000, and the charter gives the company special rights to lay its lines through the subways of New York City. The incorporators are Richard White, of New York, and James Scott and Charles King, of Jersey City." The connection of this concern with those already busy in the New York field is not stated.

ILLINOIS LIGHTING CONSOLIDATION.—Plans are being considered for the consolidation of electric lighting plants in all towns between Evanston and Waukegan. The capital of the proposed company is placed at $500,000. The territory includes twelve towns, varying in size. E. C. Cowdery, manager of the Milwaukee Gas Light & Coke Company, is behind the movement. It is believed that the Chicago & Milwaukee electric line will also be taken in.

TELEPHONE CAPITAL.—The capital stock of the Troy Telephone Company, of Troy, O., has been increased from $10,000 to $40,000. The United States Telephone Company has filed a mortgage at Columbus to the Cleveland Trust Company in the sum of $100,000.

PHILADELPHIA BELL TELEPHONE.—It is announced that the Bell Telephone Company of Philadelphia will meet March 20, when the stockholders will vote on a proposed increase of the capital stock from $4,000,000 to $6,000,000.

ELECTRIC COMPANY OF AMERICA.—The directors of the Electric Company of America have declared a semi-annual dividend of 50 cents a share, payable on Jan. 30 to stock of record Jan. 20.

DIVIDEND.—The American District Telegraph Company, of Philadelphia, has declared a quarterly dividend of 1 per cent., payable Feb. 15 to stock of record Feb. 5.

BOSTON EDISON.—The Edison Electric Illuminating Company, of Boston, has declared a 2 per cent. regular quarterly dividend, payable Feb. 1.

Commercial Intelligence.

THE WEEK IN TRADE was an uneventful one generally speaking, although the award for the New York tunnel road, for $35,000,000, opened up large opportunities in many lines of industry. It is thought that the construction work alone will require between 60,000 and 70,000 tons of iron and steel. The work in the electrical plant, auxiliaries, etc., may easily run into six or seven million dollars; and excavation is to begin in a month, requiring tools, light, machinery, etc. Some other awards of importance are mentioned affecting the electrical field and calling for large quantities of apparatus. As to general trade and prices, Bradstreet's said that they as a whole maintain the even balance which has been the leading feature for some time past, and in which it will require the advent of distinctly new features to affect any basic change. General demand is large for this season of the year, but speculation is quiet to the extreme of dullness in some lines, and especially in those branches of speculation which go to radically affect financial affairs, and therefore the volume of bank clearings. Hence it is that, comparing as we do with a period last year when stock speculation particularly was of immense volume, the aggregates for the country as a whole are considerably smaller. If, however, the clearings at the metropolis, the great centre of speculative activity, are excluded, it is found that a fair increase over last year's enormous totals is shown by the country at large. Clearing aggregates a year ago, it will be recalled, were of immense volume, next largest, in fact, to those of the spring of the year when a veritable frenzy of securities speculation was in progress. Thus, bank clearings for the week aggregate $1,718,097,191, a decrease of 8.6 per cent. from last week and of 14 per cent. from this week a year ago, but a gain of 63 per cent. over 1897 and of 32 per cent. over 1892. Outside of New York clearings are 4 per cent. smaller than those of last week, but 3 per cent. larger than those of the same week

a year ago. Business failures are fewer in number, there being 255 for the week, as compared with 295 last week, 262 in this week a year ago, 309 in 1898, 429 in 1897 and 341 in 1896. In the metal market, steel and iron are holding their own, with consumption well up to supply, while copper, New York, is again up to 16¼ cents, and lead to 4.70 cents, New York.

FIGURES OF FOREIGN TRADE.—The foreign commerce of the United States in 1899 amounted to over two billion dollars, and of this enormous sum more than three-fifths was exports and less then two-fifths imports. The exact figures, just issued by the Treasury Bureau of Statistics, are: Imports, $799,834,620; exports, $1,275,486,641; excess of exports over imports, $475,652,021. The excess of exports is larger than in any preceding year except 1898. Of the exports, manufactures form a larger proportion than ever before, while of the imports, raw materials for use by manufacturers form a larger proportion than ever before. Of the exports, more than 30 per cent. are manufactures, against 26 per cent. in the fiscal year 1897, 23 per cent. in 1895, 20 per cent. in 1885, 16 per cent. in 1879, and 12 per cent. in 1860. Of the imports, 33 per cent. are articles in a crude condition which enter into the various processes of domestic industry, against 26 per cent. in 1895, 24 per cent. in 1892, 23 per cent. in 1889, and 20 per cent. in 1885. Products of agriculture form 63 per cent. of the exports, against 70 per cent. in 1898, 72 per cent. in 1894, 74 per cent. in 1884, and 83 per cent. in 1880, while agricultural products classified as "articles of food and live animals" form 29 per cent. of the imports, against 30 per cent. in 1896, 31 per cent. in 1886, and 34 per cent. in 1884. A study of the imports and exports of 1899 compared with those of earlier years presents some interesting facts. From 1869 to 1899 imports doubled, while exports quadrupled. The imports in 1869 were $438,455,894 and the exports $337,375,988, making an excess of imports over exports amounting to $101,079,906, while, as above indicated, the excess of exports in 1899 is $475,652,051.

HEAVY WORK IN NEWFOUNDLAND.—A. C. Rice, the well-known hydraulic and mechanical engineer, State Mutual Building, Worcester, Mass., has been preparing a very complete set of drawings for a 100-ton bleached sulphite mill, a ground wood-pulp mill with 28 grinders, and a paper mill to make 150 tons of news. These mills will be located near the outlet of Grand Lake, Newfoundland. The plans call for a concrete dam about 500 feet long and 40 feet high, which will raise the normal level of the water in the lake about 6 feet, making a working head of 40 feet and a never failing power of 15,000-hp. These mills will be built and operated by Messrs. R. G. Reid & Sons, of Montreal, Canada, who own nearly all the timber and mineral lands in Newfoundland. Messrs. Reid also own and operate 600 miles of railroad, running between Port au Basque and St. Johns. Mr. Rice has also furnished Messrs. Reid with plans for developing a water power and building a 3000-hp electric power station at Petty Harbor, where there is a natural fall of 185 feet. Petty Harbor is about eight miles from St. Johns, where this power will be transmitted and used to operate their railroad shops, street car lines and lighting. The hydraulic machinery for this plant was furnished by Stilwell-Bierce & Smith-Vaile Company, Dayton, O., from special designs by Mr. Rice, and the electrical machinery by the Westinghouse Electric Manufacturing Company, Pittsburg, Pa., all of which is nearly completed, and will be in operation by April 1.

ELECTRICAL EXPORTS FROM NEW YORK.—The following were the exports of electrical material, and kindred lines, from the port of New York, during the week ended Jan. 20: Argentine Republic—159 cases electrical machinery $9317; 134 cases electrical material $4862; 12 cases electric motors $852. British East Indies—17 cases electrical material $607. British West Indies—19 cases electrical material $193; 3 cases electrical machinery $35. Brazil—8 cases electrical material $167; 2 cases electrical material $60. British Australia—1 case electrical material $198. Barcelona—46 cases electrical material $5155. Berlin—1 case electrical material $5. Central America—117 cases electrical material $840. Genoa—4 cases electrical material $8000. Hamburg—24 cases electrical material $1946; 75 cases electrical material $776. Havre—241 cases electrical material $58; 1 case electrical material $15. Japan—19 cases electrical machinery $1370; 32 cases electrical material $7038. Liverpool—96 cases electrical material $4613; 43 cases electrical machinery $954. London —320 cases electrical material $13,567; 82 cases electrical machinery $2095; 7 electrical carriages, $823. Nice—66 cases electrical material $11,283. Peru—21 packages electrical material $657. Santo Domingo—26 cases electrical material $993; 1 case electrical machinery $25. Southampton—28 cases electrical material $3703; 60 cases electrical machinery $663. Vienna—5 cases electrical material $195. Venezuela—21 cases electrical material $559.

THE EMERSON ELECTRIC MFG. COMPANY, St. Louis, advise us that they have not been able in past years to give their eastern customers as prompt service as they desire, owing to delays consequent upon transportation to the eastern territory from a point as far distant as their factory in St. Louis, Mo. Mr. Thos. T. Richards, vice-president of the Emerson Electric Mfg. Company, arrived in New York City a few days ago, and will be permanently located there in charge of their branch office, to carry a large and well assorted stock of all regular motors of their manufacture for prompt delivery to eastern territory. They expect to have this office in full running order within a very few weeks. An announcement will be made in the advertising columns of this paper when the New York office of the Emerson Electric Mfg. Company is fully equipped for attending to the wants of the eastern trade. While the 1900 model Emerson desk and ceiling fans will be similar in outward appearance to their 1899 model, the manufacturers advise us that many improvements in detail have been made, and that their product for the coming season will be found more satisfactory than it has been in the past. The catalogue giving full description of the 1900 models is now in course of preparation and will be mailed to the trade within a short time.

JAMES J. MURRAY & CO., Trenton Avenue, Culvert and Waterloo Streets, Philadelphia, Pa., manufacturers of the well-known Murray flint glass globes and shades, report that they were never so busy as at present, especially with their foreign shipments. They have recently made large shipments to the following countries: London, England, South Africa, Mexico, Australia, New Zealand, Chili, Peru, China and Japan, Havana, Cuba and also to the Philippine Islands. They are particularly busy in the manufacture of incandescent shades, arc light globes, both hand-made and paste mould globes. They are making a great many round ball globes for inside lamps. When the fragile nature of glass is borne in mind, and the long supremacy of foreign glass abroad also, these export shipments of the Murray firm are the more noteworthy and commendable.

CROCKER-WHEELER COMPANY, 39 Cortlandt Street, inform us that they have lately been closing some very large orders for motors and generators, of which news will be given out later. Their New England business has lately become so large, they have established their own office at the Worthington Building, 31 State Street, Boston, where all business originating in New England territory will be handled. Mr. Arthur L. Doremus, of their staff, is now on his way home from an extended trip across the continent, undertaken with the object of finding out the status of the electric light and power business in the different sections, and with the further purpose of giving their agents and representatives throughout the west the most complete and up-to-date information regarding their new styles and sizes of machines.

WATER POWER FOR MORRISBURGH, CANADA.—U. S. Consul Hamilton reports that, after many futile efforts, the mayor and the town council of Morrisburgh have obtained a lease from the government for twenty-five years of 250-hp. water power, to be used for the development of electric power for manufacturing industries, furnishing light for streets, houses, etc. This development will cost about $30,000, as per estimate of hydraulic engineer in charge. This power can and will be materially increased as necessities may require. The council is using every means to get manufacturers to establish there, offering free water, light taxes, and a bonus.

OUTLOOK IN HAWAII.—L. P. Matthews, of Cleveland, O., representing an eastern syndicate, which proposes to construct electric railways in Honolulu, estimates that $5,000,000 may be expended there. He said on his recent home trip: "In the near future more than a million dollars' worth of ties and lumber will be shipped from Puget Sound points to Hawaii for the projected roads. Plans already perfected call for the construction of some 310 miles of electric lines. Most of the roads will be in and around Honolulu and elsewhere on Oahu Island. Ferryboats will be run between the termini of those roads and the various islands."

MAKING AIR TOOLS BY ELECTRICITY.—The Braddock, Pa., Machine & Mfg. Company is to make machine tools, air compressors and other kinds of machinery. The buildings will be constructed by the Pittsburg Bridge Company, and will consist of a main building 60 x 300 feet, a second similar building 80 x 200 feet and a third 30 x 200 feet. It is rather curious and perhaps significant to note that the power for operating the new works will be generated by gas engines, and all machinery will be driven by electricity.

REFRIGERATING PLANTS.—The Clearfield, Pa., Brewing Company has decided to make a number of changes and additions to its plant, among which will be included a 25-ton refrigerating plant, contract for which has been awarded to the York Manufacturing Company, of York, Pa. Gaston & Francis, Long Branch, Pa., have placed contract with the same concern for a 15-ton refrigerating plant. The plant will be arranged for cold storage and fish freezing.

DELAWARE HARD FIBRE COMPANY, whose plant was recently damaged by fire at Wilmington, Del., have just let a contract for a new building, etc., to be constructed entirely of steel and brick, on land adjoining their old works. Until this new plant is in operation, the company have an abundant stock of fibre saved to fill all orders.

Special Correspondence.

NEW YORK NOTES.

New York, Jan. 23, 1900.

THE ELECTRIC LAUNCH COMPANY, of Morris Heights, New York, has purchased a manufacturing site in Bayonne, N. J., and, it is stated, will start up an establishment, in temporary buildings, within a month.

A TEN-MILE RIDE.—Electric cars on the Third Avenue Railway are now running from the post office direct to the terminus of the road at 162d Street and Amsterdam Avenue. The distance is between 10 and 11 miles.

MANHATTAN EXTENSIONS.—The Manhattan Railway Company will immediately extend its East Side line from 177th Street to the Bronx Park, at Bedford Station, as recommended by the state railroad commission. The new construction is to be adapted for the use of the electric system of propulsion.

MR. CHAS. D. KAUFMANN, secretary of the American Battery Company, of Chicago, is in New York this week, and reports his company busy filling orders in various branches of work. While in town he has taken the opportunity to investigate some of the newer fields to enter which the company is offered many inducements.

THE NEW YORK ELECTRICAL SOCIETY.—The following members were elected at the 201st meeting of the New York Electrical Society, held on Jan. 17: J. L. Kruger, 953 Myrtle Avenue, Brooklyn, N. Y.; George H. Watson, 141 Broadway, New York City; Frank H. Roth, 165 Railroad Avenue, Brooklyn, N. Y.; Joseph Hoffman, 2 West 118th Street, New York City.

MR. CHAS. BLIZARD, who has so long and efficiently conducted the New York office of the Electric Storage Battery Company, has been called to Philadelphia to become manager of the sales department. He will be in New York once a week, and to keep the work going regularly Mr. W. O. Knudson, formerly of the New York office, has been brought on from Cleveland here. The growth of the company's business is enormous.

THE KNICKERBOCKER TELEGRAPH & TELEPHONE COMPANY is in earnest in its efforts to give the people of New York an alternative telephone service. It has sent out 60 canvassers to obtain contracts for its service in this city. The contracts read that unlimited service in the boroughs of Manhattan and the Bronx shall be furnished for $60 a year, and unlimited service for the five boroughs for $120. They do not become operative until 5000 subscribers have been connected with the exchange.

ELECTRICAL WORKERS No. 3 hold their annual ball at the Murray Hill Lyceum, Thirty-fourth Street and Third Avenue, on Friday, Jan. 26, when a large and festive occasion is expected, and the Union proposes to do things in very handsome style. The Union has 1500 members, all of whom have to pass an examination by a board consisting of two members of the body, two appointed by the electrical contractors and one chosen by the four, on practical questions relating to his particular line. No. 3 is in good, prosperous condition financially, and its offices are at 85 East Fourth Street, this city.

EXTENDING THE THIRD RAIL ON BROOKLYN ELEVATED.—The preparations for introducing electric motive power on the Lexington Avenue and East New York branch of the Brooklyn Rapid Transit Company's elevated railroad system have nearly been completed, and it is very likely that the cars will be run by electricity inside of a month. The third-rail system similar to that in use on the company's Fifth Avenue line will be used and carried to Cypress Hills Cemetery. New motor cars to operate the trains and do some minor detail work is all that is now necessary to have the Lexington Avenue line in working order from the Bridge to Van Sicklen Avenue, East New York.

MR. H. C. CUSHING, JR., formerly electrical expert for the boards of fire underwriters of both Boston and New York, and lately with one of the best known insurance brokerage houses of the latter city, has opened an office at 39 Cortlandt Street, as consulting electrical engineer and fire insurance broker. Mr. Cushing's knowledge of electrical and mechanical engineering, combined with his experience as a fire insurance broker, makes his services most valuable in the placing of insurance on manufacturing plants where a thorough knowledge of electrical and mechanical detail is so essential in securing not only protection, but the lowest possible rates and broadest forms for the manufacturer.

THE ELECTRIC STAGES.—Electric omnibuses in Fifth Avenue have proved such a popular success that steps are to be taken for the equipment of the stage line with the modern vehicles at an early day. The two small omnibuses that were put on two weeks ago for experimental purposes have demonstrated their superiority over the lumbering coaches drawn by horses. They have been operated without accident, have caused no runaways, and are usually filled on all their trips to the utmost capacity. Passengers wait on street corners for them to arrive, and later have the satisfaction of passing the old-fashioned coaches. Officers of the New York Electric Vehicle & Transportation Company announce that plans have been drawn for large and commodious omnibuses, and one or two would be built and tested before an order for a quantity was given.

HEBREW TECHNICAL INSTITUTE.—The Hebrew Technical Institute has held its annual meeting. President Hoffman read his annual report, showing the progress of the school. There were, he said, about 200 pupils in attendance. The fact that the work of the school had been all they had expected of it, said President Hoffman, was shown by the quickness with which the graduates of the institution find employment. There was not, he said, at the present time a single graduate of the school out of work. Mrs. Henry Seligman, president of the Women's Committee, read a report of the work of that committee, after which Prof. Francis B. Crocker, of Columbia University, made an address on the value of manual training, and the far-reaching influence of technical education. Professor Crocker recently returned from an extended tour of the world, and in all his travels, he said, he had not found a single school better fitted for the purposes for which it was intended than the Hebrew Technical Institute. The following directors were elected: S. Morrill Banner, Julius Bien, Mrs. Ludwig Dreyfuss, Gustave Eckstein, Samuel Hirsch, Abraham Steinam, Mortimer L. Schiff, Gustave R. Tuska and Carl J. Ullmann.

NEW ENGLAND NOTES.

Boston, Mass., Jan. 20, 1900.

STORAGE BATTERY PLANT IN SPRINGFIELD.—The United Electric Light Company, of Springfield, Mass., has applied for permission to increase its capital stock $250,000 for the purpose of building a storage battery plant. Current will be generated at Indian Orchard, as is now done, and will be conducted from there to the new plant.

TESTING SYSTEMS.—To determine the best motive power for use on the Boston Elevated Railway as between the General Electric, Westinghouse and Sprague systems, the Boston Elevated Company is constructing a shed and two spur tracks in the vacant space inside the North Station loop to be used in making tests with dummy trains in the subway between the hours of midnight and 6 a. m., when the subway is closed to regular traffic. The officials of the Manhattan Elevated, of New York, will be represented at the tests.

TO MAKE AUTOMOBILES IN NEW HAVEN.—A new automobile company is to be started in this city in the near future, under the name of the Kidder Motor Vehicle Company, which was incorporated in Delaware a few days ago. The new company is capitalized at $500,000, and is to manufacture and sell automobile carriages, cabs and omnibuses. The capital interested in the scheme is all local, and is chiefly furnished by T. Atwater Barnes, president of the New Haven Trust Company, and by Charles R. Bishop, president of the Bishop Box & Paste Company. The new company plans to locate here immediately, and to commence at once the manufacture of automobile vehicles. A large factory will be rented at once and an improved plant constructed at a later date. The company proposes to put some vehicles on the market by a year from now, and also expects to be able to open an electric vehicle stage line through the principal streets of the city. New Haven has two automobile manufactories and two promised automobile stage lines already.

PENNSYLVANIA AND OHIO NOTES.

Pittsburg, Pa., Jan. 20, 1900.

MR. CHARLES F. SCOTT, the chief electrician of the Westinghouse Electric & Manufacturing Company, has been elected vice-president of the Western Pennsylvania Engineers' Society of this city.

THE UNITED TRACTION COMPANY, of this city, has issued a statement of its operations for the six months ending Dec. 31, 1899, according to which the surplus at the end of that period is $181,516.

THE OLD WORKS of the Westinghouse Electric & Manufacturing Company, on Garrison Alley, Pittsburg, are going to be occupied by the R. D. Nuttall Company, of Allegheny City, manufacturers of gears and trolleys.

A CHARTER and franchise has recently been granted to the Oil City Traction Company, of Oil City, Pa., and this company will at once begin to construct electric railway lines connecting Oil City, Franklin, Titusville and Pleasantville, a total distance of 13 miles.

SUPERINTENDENT MORRIS MEAD, of the department of electricity of this city, is now installing an electrical signal code in his office, by which it will be possible for the police throughout the city to communicate with the fire department at any time of the day or night.

THE PITTSBURG & SOUTHERN STREET RAILWAY COMPANY was incorporated at Harrisburg yesterday at a capitalization of $12,000. The object of this company will be to construct an electric railroad in this city to connect the lines of the Consolidated Traction Company and the Suburban Traction lines.

PROF. REGINALD A. FESSENDEN, who has been professor of the electrical engineering department of the Western University of Pennsylvania, of this city since 1893, has accepted a position with the United States Signal Service Bureau at Washington, D. C., and he will take hold of his new work at once.

ELECTRIC LIGHT PLANT BUILT BY PUPILS.—Profs. R. S. Orr and G. L. Milligan, instructors of the Manual Training School of the Ninth Ward, Allegheny City, with the assistance of their students, have completed and installed an electric lighting plant, which is said to be a wonderful success and the pupils are very proud of their achievement. The plant consists of a dynamo, a gas engine and the necessary switchboard appliances. It has a capacity of about one hundred 16-cp lights.

Cincinnati, Ohio, Jan. 20, 1900.

A LOT HAS BEEN purchased on Government Square, near Walnut Street for the Edison Company's new office building, and work will commence soon. Besides the offices the building will contain a storage battery to take care of the central distribution of service. It means an outlay on the part of the Cincinnati Edison people of not less than $100,000.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY has presented and set up in the department of physics of the University of Cincinnati one of Professor Ewing's hysteresis instruments for determining the magnetic quality of iron and steel used in the building of pole pieces and armature cores. The Bullocks, it may be observed, are excellent friends of the institution.

THE ELECTRIC RAILWAY & EQUIPMENT COMPANY.—In anticipation of the frequent flooding of the bottoms through the rise in the Ohio River, General Manager William A. McCallum, of the Electric Railway & Equipment Company, it is understood, is hunting for new quarters for that rapidly growing business which is now located on Front Street, just east of

Broadway—in the heart of the periodically inundated district. There is grave danger of another February flood this year, and the company has urgent need of every working hour to get out the business ordered.

Cleveland, Ohio, Jan. 20, 1900.

THE BELL TELEPHONE COMPANY has completed placing an underground cable system at Salem.

THE TROY TELEPHONE COMPANY, of Troy, Ohio, has increased its capital stock from $10,000 to $40,000.

THE DELTA HOME TELEPHONE COMPANY, of Delta, has commenced operations with 75 telephones.

MR. W. A. LYNCH, of Canton, has revived his project of building an electric road from Canton to Akron, and since he has secured ample backing, the road is said to be assured.

THE HANCOCK ELECTRIC LIGHT & POWER COMPANY, of Findlay, and the Findlay Street Railway Company, of the same place, have consolidated, the latter purchasing the former plant for $40,000. Both companies are controlled by George Kerper and associates of Cincinnati.

A MEETING OF REPRESENTATIVES from the various interurban electric railways centering in Columbus was held in that city on Jan. 16, to discuss several questions of importance, among them a proposition to build a large union power house; the question of standard gauges; also the effecting an arrangement with the Columbus Railway Company to enter the city over its lines. At the present time none of the interurban roads enter the heart of the city and they are very anxious to get in.

INDEPENDENT TELEPHONE INTERESTS.—Representatives of the non-Bell telephone interests of Ohio, Indiana, Michigan and part of Illinois who have been in session here recently, arranging for long distance business between the various local companies, completed their work, with the exception of some minor details, and adjourned. It is probable that a general basic rate of half a cent per mile will be adopted for distances greater than 40 miles, distances to be calculated on an air line. For less distances than 40 miles there will be an arbitrary scale of rates, with a minimum of 10 cents and a maximum rate of 20 cents.

THE TIFFIN, TOLEDO & SANDUSKY RAILWAY COMPANY, which is planning to operate an electric road between the points mentioned in the title, will be fully organized at a meeting to be held in the near future. George D. Loomis, of Tiffin, will be president of the company, and interested in it are H. F. Frey, W. M. Starr, Richard Young and R. M. Brown, of Washington, D. C.; J. M. Naylor, J. C. Yingling and J. F. Bunn, of Tiffin; F. E. Anderson, of Alexandria, W. Va.; Samuel P. Caloff, a Connecticut capitalist, and several Toledo gentlemen. The road will probably be built in three sections; one line running from Tiffin to Fremont and then to Port Clinton, a second division following the lake shore from Port Clinton to Toledo, and a third division running east from Port Clinton to Lakeside, Marblehead and Sandusky. To get to the latter place it will be necessary to cross Sandusky Bay on a long bridge paralleling the Lake Shore Railroad bridge. The shops, car sheds and power house will be located at Port Clinton. Regarding the power house Mr. F. J. Bunn states that three three-phase alternating current will probably be used, and that the initial installation will probably consist of three 1200-hp units. There will also probably be seven substations.

WESTERN NOTES.

Chicago, Ill., Jan. 20, 1900.

MR. G. G. LUTHY, general manager of the Peoria Electric Company, Peoria, Ill., is visiting Chicago this week.

THE HEWITT-LINDSTROM MOTOR COMPANY has been incorporated in this city to manufacture automobiles, motors, etc. The incorporators are T. W. Brown, G. Adam Bruck and Leo N. Broecker. The capital stock is $30,000.

NO PROFIT IN MAKING STREET CARS.—The manufacture of street cars in Pullman will be abandoned in a few weeks. The street car shops have been unprofitable for the last five years, and the plant will be converted into repair shops.

MR. GUY V. WILLIAMS, who for the past two years represented the Columbia Incandescent Lamp Company in Minneapolis, has resigned his position with that company to accept one with the Bryan-Marsh Company, as manager of the Northwest District Office, with headquarters at Minneapolis.

THE MARTIN J. INSULL COMPANY report that they have recently secured some large orders for alternating and direct current arc lamps; also orders for a large lighting and railway switchboard for the Rockford Edison Company, and a large railway board for the Union Traction Company, of Anderson, Ind.

THE CHICAGO UNION TRACTION COMPANY will in the near future inaugurate a buffet service on street cars. The arrangement will be similar to that between the Pullman Company and the railroads. The cars will be run at stated intervals, always as trailers, and will be conducted as well as any transcontinental dining car. Besides coffee and luncheon, cigars and liquors will be obtainable. An extra fare of 5 cents will be charged for the privilege of riding on the buffet.

DEMAND FOR AUTOMOBILES.—Fifty cabs and 50 broughams have been ordered by the General Carriage Company, of New York from the Woods Motor Vehicle Company, of Chicago. Six cabs have already been shipped to New York and the rest of the order will be filled at the rate of 10 a week. The Woods Company, on Jan. 20, received an order for 50 cabs from Buffalo. The Woods Company now has 25 cabs in daily service in Chicago and 25 more in the factory which will be out within a few weeks.

Milwaukee, Wis., Jan. 20, 1900.

DISSOLUTION OF PARTNERSHIP.—The firm of Rohn & Meyer has dissolved partnership. Mr. George F. Rohn will continue the electrical contracting business at the old stand, 448 East Water Street.

TROLLEY FUNERAL CAR.—The first funeral to be held on the lines of the Milwaukee Electric Railway & Light Company was recently held. If the demand warrants it a special funeral car will be built by the company.

THE WOLF RIVER TELEPHONE COMPANY has applied to the city of Kaukauna for a franchise. A rate has been made, much lower than given by other companies. The company now owns 550 miles of lines in Wisconsin.

RAILWAY PLANS KEPT SECRET.—Prospectors are laying out a line for an electric road between Kenosha and Waukegan. The company interested in the plan of building the line is keeping the plan a secret. Options have been taken on land south of Kenosha, and the farmers are interested in the prospects.

TELEPHONE LINES PURCHASED.—On Jan. 5 the Wolf River Telephone Company completed the purchase of the lines and franchises of the Badger Telephone Company. The latter had about 50 miles of toll line besides, and exchange in Waupaca. The Badger line extended from Waupaca into Waushara County, and will make an important feeder to the Wolf River system. The Waupaca exchange will be rebuilt immediately.

THE ANNUAL MEETING of the Merrill Telephone Company was held on Jan. 10, at which the following officers were elected: President, H. R. Lehland; vice-president, P. E. Berard; treasurer, S. Heineman; secretary, H. R. Allen; superintendent, Jule Thielman; directors, three years, H. R. Allen, W. H. Flett, J. T. Drinker. Reports showed the company in excellent condition, with nearly 300 instruments in operation and the list continually increasing.

THE MILWAUKEE HARVESTER COMPANY has awarded the contract for the electrical machinery for their new power plant to the Westinghouse Electric & Manufacturing Company. Mr. Charles Armstrong, of Chicago, is the consulting engineer for this plant. The contract includes the following machinery: Two 250-kw and one 180-kw, 440-volt alternators; one 60-hp, two 50-hp, two 40-hp, three 25-hp, two 20-hp, four 15-hp, two 10-hp and one 5-hp, 440-volt induction motors.

MR. L. F. COOK has interested several Milwaukee business men who have agreed to bear the expense of the construction of one mile of elevated electric road as an experiment. Mr. Cook claims he can safely run trains through city streets at a speed of 60 miles an hour. These business men have agreed to pay the cost of a practical demonstration of the system, which is estimated at $50,000. If it is a success then a road will be built to Chicago. As soon as the Milwaukee capitalists who are interested in the road approve of the contracts articles of incorporation of the Milwaukee Elevated Electric Railway will be filed.

THE ANNUAL MEETING of the stockholders of the Little Wolf River Telephone Company was held in Weyanwega on Jan. 11. The election of officers resulted in the selection of E. H. Jones, of Weyanwega, president; John T. Boyle, of Fond du Lac, vice-president; A. L. Hutchinson, of Weyanwega, secretary and treasurer. Frank H. Sweet, of Fond du Lac, was elected a director in place of Mr. Stewart, of Clintonville. The directors chose H. E. Kepler, of Fond du Lac, superintendent. A dividend of 10 per cent. was declared. It is not expected that the headquarters of the company will be removed to Fond du Lac immediately.

THE MILWAUKEE ELECTRIC RAILWAY & LIGHT COMPANY has just completed the extension of its 2400-volt, two-phase alternating current service to the south side, a distance of about 2½ miles. The entire run is underground in vitrified conduit. This company early last summer extended this service to the town of Wauwatosa, a distance of about five miles. Formerly Wauwatosa was furnished current by this company, but a local power house was operated. This plant was shut down and turned into a transformer house. Two thousand incandescent and 10 arc lamps are supplied on the three-wire system, which was the system under the old arrangement. The new system has proved very satisfactory. The line from Milwaukee to Wauwatosa is an underground run in Milwaukee as far as the city limits, and hence overhead to Wauwatosa.

Minneapolis, Minn., Jan. 20, 1900.

THE MINNESOTA TELEPHONE COMPANY, with headquarters at North Branch, is negotiating with the Mutual Telephone Company for the purchase of the latter's system.

THE NORTHWESTERN TELEPHONE COMPANY, of Rush City, Jan. 10, elected the following officers: President, A. J. Stowe; vice-president, P. M. Peterson; secretary, S. A. Nebel; treasurer, J. C. Carlson. The company will extend their lines to adjoining towns early in the spring.

TELEPHONE RATES REDUCED.—The Northwestern Telephone Company, of Minneapolis, has made another cut in its toll rates, and on the first of January a new schedule went into effect covering the entire territory, reducing the rate for a three-minute talk from 25 cents to 15 cents for all points within 25 miles of each other.

MUNICIPAL LIGHT AGITATION IN DULUTH.—The agitation for municipal electric lighting plant at Duluth has stirred the Commercial Light & Power Company to an offer of 480 2000-cp lamps at $24,840 per year, somewhat less than the city experts figure they can furnish a similar light for. It is quite probable that this offer may result in delaying the construction of a municipal plant. The council has, however, voted to refer the matter to a general election.

Indianapolis, Ind., Jan. 20. 1900.

A NEW ELECTRIC LIGHT PLANT.—The common council of Frankfort has voted to accept plans and specifications prepared by electric architects for a municipal electric light plant.

FRANCHISE ASKED.—The Indiana & Ohio Traction Company has filed a

petition with the Huntington city council, asking for a franchise to operate a street car system in the streets of that city.

WANT MUNICIPAL OWNERSHIP.—The citizens of Washington Daviess County want municipal ownership of the electric light plant, and a deal may be made if the council can see the way clear to pay for it.

THE MUGG TELEPHONE COMPANY was incorporated on Jan. 6. Capital stock, $1000. Lines will be built in Owen and adjoining counties. The directors are Joseph T. Mugg, Benjamin F. Mugg and Thomas H. Morris.

DAMAGES ALLOWED.—Judge Baker, of the federal court at Indianapolis, has allowed the New Telephone Company $13,800 as damages or expense by reason of requiring it to take up its conduits, pipes and cables built in the square selected for the new post office building.

INDIANA AUTOMOBILES IN PARIS.—The Indiana Bicycle & Automobile Company, of Indianapolis, has completed arrangements for a large amount of floor space at the Paris Exposition. It has engaged in active competition with European manufacturers and the results are already gratifying.

INDEPENDENT TELEPHONE COMPANY ABSORBED.—The Central Union Telephone Company has absorbed the Independent Telephone Company at Muncie. This company was owned and controlled principally by David Allen, of Frankfort, now leading a company in the Philippines.

ANOTHER ELECTRIC RAILWAY PROJECT.—Plans are being formulated to build an electric railroad from Madison to Versailles and thence to Greensburg. Mr. Grant Johnson, president of the branch of the Black Diamond, is pushing the enterprise and meeting with much encouragement.

ELECTRIC COMPANY REORGANIZED.—The Rockville Electric Power & Light Company has been reorganized. The plant is to be overhauled, new buildings erected and new machinery, boilers, etc., purchased. The officers are: J. S. McFadden, president; W. J. White, secretary, and F. H. Nicols, treasurer.

GEARED TO FIFTY MILES PER HOUR.—The Union Traction Company has ordered the motor cars intended for the Muncie-Indianapolis line geared to 50 miles an hour. An all-night service is possible between the two cities, and at least one train will leave Indianapolis about midnight or after the theatres for Muncie and intermediate points.

A TELEPHONE SYNDICATE.—When the election of directors of the National Telephone & Telegraph Co., of Fort Wayne, was held Martin Maloney, of New York; Cunningham McMillan and J. B. McCall, of Philadelphia, were chosen. This is the first time that foreign capitalists have appeared in the directory of this company, and is regarded as a confirmation of the project of the eastern capitalists to secure control of enough independent telephone lines in the country to make a formidable showing against the Bell Company this year.

A POWER SCHEME.—A number of moneyed men of Decatur are interested in an unique scheme or project to give the community current for electric lighting, heating, power, etc., at a minimum cost. They propose to cut a canal across the neck of a loop in the Salamonie River, a distance of little over a quarter of a mile, while the distance around the bend is three miles. The fall would be 30 feet and would afford good power. The plan is to lay cables from the power station to the towns and cities within a radius of 40 or 50 miles, and these places would be furnished with electricity at a very low cost. The matter is being seriously considered by a number of capitalists of Decatur and surrounding cities, and a company is said to be almost in shape for incorporation.

St. Louis, Mo., Jan. 19, 1900.

MR. W. O. GARRISON has been elected president and Mr. A. C. Garrison, vice-president and treasurer of the Columbia Incandescent Lamp Company for the ensuing year. The office of secretary has not yet been filled.

TEMPORARY LIGHTING BILLS.—Three temporary lighting bills were passed Jan. 15 by the city council. The mayor signed them without delay. It will be nearly three weeks, however, before the alleys and city institutions can be lighted under their provisions.

SUITS FILED.—The collector of taxes on Jan. 17 filed suit against the St. Louis & Suburban Railway Company for $20,007, alleged to be due on back taxes for the year 1899. A similar suit was also filed against the St. Louis & Meramec River Railroad Company for $4591.

WATER AND LIGHT CONTRACT LET.—The city council, of Casey, Ill., awarded a contract Jan. 3 to the Commercial Electric Company, of Chicago, for the erection of a joint system of water works and electric light, at a cost of $36,000. The plant is to be completed and turned over to the city by June 15, 1900.

LONG DISTANCE TELEPHONE SERVICE.—The Kinloch Telephone Company has made arrangements with the independent telephone lines throughout the state for long distance service. Connections will be made as soon as possible. The matter was agreed upon when the independent companies held their meeting here a short time ago.

ST. LOUIS & SUBURBAN RAILWAY COMPANY.—The annual meeting of the St. Louis & Suburban Railway Company was held Jan. 8, and the following officers re-elected: C. H. Turner, president; Samuel M. Kennard, vice-president; T. C. Kimber, secretary and treasurer; C. H. Turner, C. S. Maffett, J. B. Case, James Green, Henry Nicolaus, Samuel M. Kennard, James Jackson, Boston, Mass.

TELEPHONE EXTENSIONS.—The Kinloch Telephone Company has applied to the Board of Supervisors at Belleville, Ill., for a franchise to establish a telephone system through St. Clair County, Ill. The supervisors are in favor of the plan, but desire that the company fix a rate for rural subscribers and put one telephone in each township for the free use of the supervisors and other county officials.

WANT CHEAPER TELEPHONE RATES.—The citizens of Jefferson City, Mo., are trying to organize an independent telephone company which will furnish telephones at $1 per month. The Missouri & Kansas Telephone Company now charges $2 per month for residences and $3 for offices and business houses. A committee has been appointed to confer with the Kansas City Mutual Telephone Company in the hope of putting in a system here at that rate.

San Francisco, Cal., Jan. 14, 1900.

MR. SIDNEY SPROUT, electrical engineer, has moved to new offices, Rooms 191 and 192 Crocker Building, San Francisco.

A NEW YEAR'S WEDDING.—James H. Follis was married to Miss Mary Gwin on Jan. 1. The groom is interested in the Brooks-Follis Electric Company, San Francisco.

THE BUTTE COUNTY ELECTRIC POWER & LIGHT COMPANY expects to begin operating its electric transmission plant, located 11 miles from Chico, Cal., inside of one month. A large amount of electric power will be transmitted to supply gold dredgers operating on the bars of Feather River, Cal.

SALE OF ELECTRIC LIGHT FRANCHISE.—The Healdsburg (Cal.) electric lighting franchise was recently sold as is required by the state law. Only one bid was put in, that of the city of Healdsburg, to which the franchise was sold for $25 and 5 per cent. of the business of that part of the line which passes over the county road.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY recently closed a contract with the San Francisco & San Mateo Electric Railway Company for electric apparatus for a substation, so that current purchased from the Independent Electric Light & Power Company can be utilized to operate the road. Included in the contract are four 400-kw rotary transformers and ten 200-kw lowering transformering designed for 10,000 volts in the primaries.

PROF. PERRINE TO SETTLE IN THE EAST.—Prof. F. A. C. Perrine recently severed his connection with Stanford University in order to accept a position in the east. It is currently reported that he will be connected with the Stanley Electric Manufacturing Company in Pittsfield, Mass. Professor Perrine has been absent from Stanford on leave for the past 18 months. He left the university temporarily to engage in important engineering work for the Standard Electric Company's Blue Lakes transmission, and has since resided in San Francisco. His position in the university has not yet been filled by a successor.

THE SAN FRANCISCO SUPERVISORS have passed another telephone license order, which amounts to a substitute for that which was recently vetoed by the mayor because the city attorney pronounced it invalid. The new ordinance provides that any person, firm or corporation owning and operating telephones in this city and county must, within 10 days after the passage of the order and every quarter after that, make a sworn statement of the number of telephone instruments in use by said person, firm or corporation and pay into the city treasury the sum of 50 cents for each instrument in use. A fine of $100, or six months' imprisonment, or both, is imposed as a penalty for failure to comply with these provisions. An order was passed which prohibits telephone companies from receiving compensation for giving a switch before the party called up shall have answered.

THE WYBRO-HENDY COMPANY, of San Francisco, has just completed an electric lighting plant for the new United States Navy Training School, situated on Yerba Buena Island, in San Francisco harbor. The commandant's house and officers' quarters are lighted also by the same plant. A 30-kw Bullock generator is direct connected to a Harrisburg Ideal engine. The company is installing an independent electric lighting plant at each of the batteries commanding San Francisco bay. The Bullock dynamos, which are installed throughout, vary in capacity from 6-kw to 20-kw. They are direct connected to Hornsby-Akroyd kerosene engines. A few motors are to be used for ammunition hoists. An 800-kw railway generator has just been shipped from the Bullock Company's works to fill a contract taken by the Wybro-Hendy Company in connection with the remodeling of the Oakland Transit Company's Piedmont power house. The generator will be direct connected to the engine, which now drives a cable drum, and it will make 70 revolutions per minute.

CANADIAN NOTES.

Montreal, Que., Jan. 20, 1900.

THE NEW BRUNSWICK TELEPHONE COMPANY has decided to build a line from Frederickton, N. B., to Chatham.

PEMBROKE, ONT.—The by-law to borrow $30,000 to install a municipal electric light plant has been carried by the ratepayers.

THE MOUNT ROYAL PARK INCLINE RAILWAY COMPANY has appointed a committee to confer with electrical companies as to the conversion of the power plant from steam to electricity.

MR. FARLEY, city engineer of Hull, Que., is preparing plans for the new electric light station to be built on Brewery Creek. It is the intention of the council to install the necessary plant at once, for which tenders will be invited. There will be two 50-light dynamos, although 75 lamps only will be installed at first. There will be about eight miles of wire.

PATRIOTISM AT HALIFAX.—Amid a great display of patriotism the first section of the second Canadian contingent embarked on the Laurentian at Halifax, N. S., Jan. 20, for South Africa. A warm demonstration took place in the harbor, led by the Commercial Cable Company's steamer Mackay-Bennett. The Mackay-Bennett was decorated with bunting and flew a huge union jack and an equally large American flag. When the cable steamer sighted the transport through the fog, her commander gave a signal by whistle, and a salute was fired. The other ships took up the chorus, sounds of whistles, rockets and guns filling the air. Hearty cheers were given from the cable ship, and were answered from the transport. Then the cable company's crew sang "God Save the Queen."

Ottawa, Ont., Jan. 20, 1900.

ELECTRIC LIGHTING IN CANADA.—According to the report of the inspector of weights and measures for the year ending June 30, 1899, there were

doing business in Canada 276 companies or individuals supplying electric light, having a total of 630,732 lamps.

THE BOARD OF TRADE for St. Catharines, Ont., has passed a resolution asking the city council to take steps to secure legislation granting the corporation the right to develop electrical power and erect factories as an inducement to manufacturers to locate in that city.

THE CATARACT POWER COMPANY, of Hamilton, Ont., is considering the extension of the radial railway system of that city to Oakville. It is also probable that the Toronto Electric Railway Company will extend its road to Oakville, thus completing an electric line between Hamilton and Toronto.

INCREASED RECEIPTS.—The receipts of the Toronto Electric Street Railway increased from $1,187,662 in 1898 to $1,315,049 last year, a gain of $127,387. The average daily receipts increased $349. For the month of December last the receipts amounted to nearly $120,000, as against $84,000 in December, 1896.

THE COATICOOKE ELECTRIC LIGHT & POWER COMPANY, of Coaticooke, Que., is increasing its lighting plant by the installation of another 2000-light alternator with switchboard. The company is also catering for electric power, for which purpose it has bought a 100-kw, 550-volt direct current generator with switchboard complete.

LABRADOR ELECTRIC COMPANY.—Mr. Raymond F. Prefontaine and a number of associates will apply to the Quebec legislature for an act to incorporate themselves as the Labrador Electric Light & Power Company to acquire and develop water power on the Murray Bay River and to build electric railways in the counties of Charlevoix, Chicoutimi and Saguenay.

CONTRACT FOR ELECTRICAL POWER.—Messrs. R. and W. Conroy, of Deschenes, Que., have contracted with E. B. Eddy, of Ottawa, to deliver 2000 electrical horse-power at the Eddy mills at Hull, Que. The contract is for a period of 10 years, renewable afterward for a further time if desired. The price per horse-power per annum is $15, making a $30,000 yearly contract. The Conroy Bros. will put up the necessary power house and other buildings at Deschenes, and Mr. Eddy will use the power supplied for running his pulp mills and his other factories, at which the power has to be delivered.

TORONTO'S STREET CAR TRAFFIC.—By a new time table inaugurated by the Toronto Electric Street Railway Company, an increase of 4000 miles per day run by the cars was effected. On the day upon which the figures were taken 232 cars were in use, which ran 25,520 miles and carried 115,701 passengers, whose fares amounted to over $4000. On the same date last year there were 210 cars in use, which ran 21,547 miles, and carried 82,292 passengers, whose fares amounted to $3848, thus showing an increase of 3673 miles traveled, 22,400 passengers and $987 in receipts. The Toronto street cars, therefore, run a distance, every day, equal to the circumference of the globe, and carry about one-half of the total population of that city.

MR. DUNCAN McDONALD, superintendent of the Montreal Electric Street Railway, has patented an arrangement for gradually applying power to street railway motors. On the top of the controller is a series of eight steps, placed at equal intervals along the arc of a circle. Attached to the handle is a spring arrangement in connection with these stops. The handle runs around freely until the first stop is encountered, which cannot be passed until pressure on the handle top releases the controller arm, and so on until the entire arc has been traversed. In order to go from standstill to full power ahead, a lapse of from eight to ten seconds is necessary. The turning off of the power can be done, as formerly, with one sweep of the handle. Another improvement connected with the device is an automatic lock, by which it will no longer be necessary for the motorman to take the handle with him on leaving the car, in order that the accidental application of the power can be avoided.

General News.

THE TELEGRAPH AND TELEPHONE.

SANTA FE, N. MEX.—The Southwestern Telephone Company has been incorporated here with a capital of $25,000, and this year will build 250 miles of long distance telephone line.

ONEONTA, N. Y.—The Central New York Telephone Company has advanced the rates in Oneonta for private residences from $12 to $21, and for business places from $15 to $27.

GREENSBURG, PA.—The Westmoreland Telephone Company of Greensburg has sold its franchise to the Telegraph & Telephone Company, of America, the consideration being $25,000.

SPRINGFIELD, ILL.—The Saline County Telephone Company, of Galatia, has been incorporated. Capital, $10,000. Incorporators, C. Le Tempt, G. H. Mitchell, T. E. Webber, all of Galatia.

ST. LOUIS, MO.—The capital stock of the St. Francois County Telephone Company has been increased from $500 to $5000. The company is placing telephones in all the towns in the country.

CHARLESTON, W. VA.—The Midland Telegraph Company, Chicago, Ill., has been incorporated here. Capital, $5,000,000. Incorporators, F. E. Crawford, W. R. Stewart, Jr., J. R. Voult, P. B. Coffin, G. M. Seward, all of Chicago.

CHARLOTTE, N. C.—The state of North Carolina has chartered the Carolina Telephone & Telegraph Company, with headquarters at Tarboro. Stockholders, George Holderness, W. H. McNair and W. H. Powell. Capital, $50,000, with privilege to increase to $150,000. Lines are to connect different towns in the state.

LOUISVILLE, GA.—The representative of the Waynesboro Telephone & Telegraph Company has been granted a franchise by the town authorities to erect a telephone exchange in Louisville. The company is erecting a line from Waynesboro to Louisville, which is to connect with the Southern Bell Telephone Company.

NEW ULM, MINN.—The New Ulm Telephone Company will be merged into the Southern Electric Company, the latter having purchased the local exchange, paying $11,000 for its equipment in this city. The Southern now owns and controls four local exchanges—New Ulm, Redwood Falls, Sleepy Eye and Springfield—with toll lines to Tracy on the west and Hanska on the east.

TIFFIN, OHIO.—A million dollar mortgage on the real estate and chattel property of the United States Telephone Company, to the Cleveland Trust Company, as trustee, was placed on record in the office of the recorder of this county. The mortgage covers 14 telephone toll lines extending throughout 25 counties of the state. It is due in 20 years and bears 5 per cent. interest.

NORTH PARMA, MICH.—The North Parma Telephone Company organized in April, 1899, for the purpose of building party lines through the farming community has at this writing five lines with from 12 to 21 telephones on each. It is extending from Parma to Springport and Parma to Devereaux. The company is managed on the co-operative plan and thus far has been very successful. James A. Dean is president and B. L. Hubert, secretary.

JERSEY CITY, N. J.—The Midland Telephone Company, which was incorporated recently with a capital stock of $15,000, is said to be a subcompany of the American Bell Company, which will operate in New Jersey. It commences business with a paid-in capital of $5000, and the charter announces that the company will string wires between Jersey City and Philadelphia. The Midland Telephone Company was formed to conform with the New Jersey law and will be operated by the officials of the New York & New Jersey Telephone Company.

ALBANY, N. Y.—The Black River Telephone Company has been incorporated. Its general route is to be from Watertown to Utica, connecting as principal points Carthage, Lowville, Boonville and Rome, including the villages of Delta, Lee, Lee Center, West Branch, Ava Corners, West Sydney, Mohawk Hill, Bryon's Corners, Constableville, Turin, Port Leyden, Leyden, Lyons Falls, Houseville and Martinsburg. The capital stock is $25,000, of which $5000 is to be preferred stock, entitled to 6 per cent. annual dividends. The directors of the company for the first year are John J. Domser and Philip Domser, of Lewis, Lewis County; Fred C. Myers, of Sylvester; C. Caypron and Benedict Gantner, of Leyden, Lewis County; Homer C. Markham, of Lyons Falls; David Swancott and Frank Harrington, of Lee.

ANDERSON, IND.—One of the most unique telephone systems in the country is in operation here. It is a long distance line and the wire is the upper strand of a barbed-wire fence. The line is 12 miles long, connecting Anderson, Pendleton and Ingalls, and will soon reach over to Greenfield, a distance of 15 miles. Only the top wire is now used, but within a few weeks all the six wires of the fence will be in service, and the system, though apparently ridiculous in conception, will be complete for all practical purposes and a money maker. The system is the project of Cassius Alloy, of Pendleton. He found that the farmers between Pendleton and Ingalls had a continuous line of barbed-wire fence, save for a few short distances, that he could easily span, and soon the line was complete. A factory at Ingalls and the factory office at Anderson are connected, likewise two stores, one at Pendleton and one at Anderson. Other places will be put on the line right away. The system works well.

ELECTRIC LIGHT AND POWER.

COLUMBUS, GA.—The Columbus Power Company has increased its capital stock from $200,000 to $300,000.

OXFORD, PA.—A new 150-hp engine is being added to the electric light plant at Oxford.

PHILADELPHIA, PA.—An electric light plant is being erected at the Chester Springs Soldiers' Orphans' School.

WOODBURY, N. J.—The Woodbury Electric Light Company has decided to put in a plant for incandescent lighting.

WASHINGTON, D. C.—The contract for the erection of an electric lighting plant at the Norfolk navy yard has been awarded to L. L. Leach & Son, of Chicago, for $73,271.

LISBON, N. H.—The Lisbon Electric Light Company and the Lisbon Power Company have been consolidated and a new company organized, with a capital stock of $30,000.

ST. PAUL, MINN.—The Owatonna Light, Heat & Power Company has been granted a franchise to build a plant at Owatonna, Minn., and will furnish gas, heat and electric lights in that city.

LOWELLVILLE, OHIO.—This village has voted to issue $8000 in bonds for the purpose of building an electric light plant. The sale of the bonds was advertised to take place on Jan. 23. No contracts have yet been let.

MINNEAPOLIS, MINN.—Articles of incorporation of the Highland Canal & Power Company, Minneapolis, have been filed with the secretary of state. The capital stock is placed at $50,000, and the debt limit at $3,000,000.

CLEAR LAKE, MINN.—At a meeting of the Clear Lake Electric Light & Power Company, it was decided to double the capacity of the plant. The power house will be rebuilt. The capital stock was increased from $10,000 to $20,000.

SCRANTON, PA.—Newton Jackson, of Scranton, representing a syndicate, has purchased the plant of the Kennett Electric Light, Heat & Power Company, which lights the boroughs of Kennett Square, Avondale and West Grove.

ALBANY, N. Y.—The Coeymans Electric Company has been organized at Coeymans. Capital, $50,000. Incorporators, W. F. Inman, J. N. Drake, both of New York City; J. F. Montigani, of Albany; L. E. Conger, C. L. Diston, both of Coeymans.

NEW BRIGHTON, N. Y.—The New Brighton Electric Light, Heat & Power Company, of Staten Island, has been incorporated to furnish heat, light and power for public and private use. Capital, $1000. Directors, William Murphy, George Irving, John Irving, all of New Brighton.

SALT LAKE CITY, UTAH.—The Utah Light & Power Company, Salt Lake City, has been incorporated. Capital, $3,500,000. Incorporators, L. Snow,

G. Q. Cannon, J. P. Winder, J. T. Smith, R. Clawson, L. S. Hills, T. G. Weber, W. S. McCormick, R. S. Campbell, M. Shepherd, all of Salt Lake City; J. J. Banigan, of Providence; W. J. Curtis, of New York City.

BELLEVUE, OHIO.—The Bellevue Light & Power Company contemplates the addition of a power circuit providing a sufficient number of consumers can be secured. Officers of the company have been elected for this year, as follows: C. H. Stewart, president; G. A. Wright, treasurer; Howard Brooks, secretary and manager; directors, C. H. Stewart, G. A. Wright, H. Brooks, Jessie Vickery, W. H. Price.

KANSAS CITY, MO.—The electric lighting business of Kansas City is in new hands. At the annual election of directors of the Edison Electric Light & Power Company and the Kansas City Electric Light Company the two companies passed into the control of the Armours, of Kansas City and Chicago; Robert Fleming, of London; C. F. Holmes and W. H. Holmes. The investment is over $1,000,000.

CLYDE, N. Y.—The plant of the Clyde Gas & Electric Company at Lyons, N. Y., has been taken charge of by Sheriff Wheeler under six judgments, aggregating $1642, obtained by Syracuse creditors. The stockholders of the company have petitioned Justice Dunwell for a voluntary dissolution of the corporation, and an order has been issued to show cause why the corporation should not be dissolved, the order being returnable Feb. 1. The value of the plant is placed at $71,344; uncollected accounts, $990; liabilities, $50,279. The Clyde Gas & Electric Company supplies electric light, heat and power, as well as steam heat. It also owns a gas plant.

THE ELECTRIC RAILWAY.

NEW CASTLE, DEL.—The right of way wanted by the New Castle & Delaware City Railway Company has been secured, and the contract to build the line will soon be awarded.

RICHMOND, VA.—The Newport News & Old Point Railway & Electric Company is now building its new powerhouse on Hampton River, near the corporate limits of the town.

CLINTON, N. J.—The project of building a trolley line from High Bridge to Clinton is being seriously considered by the citizens of those places. The distance is two and a half miles.

RICHMOND, VA.—The City Street Car Company, under a charter as the City Gas Company, has erected a plant at a cost of $30,000, and is about to extend its car lines at an expenditure of $25,000.

GASTONIA, N. C.—There is an evident sentiment in this place in favor of an electric street railway. An electric light plant is to be installed here, the issue of $15,000 bonds having been authorized for the purpose.

YONKERS, N. Y.—The car barns of the Yonkers Electric Railroad Company in Riverdale Avenue were destroyed by fire recently. There were 15 cars in the building, mostly open ones. They were all destroyed.

TOLEDO, OHIO.—The Toledo, Fremont & Norwalk Electric Railway Company has executed a trust mortgage to the Union Trust Company, of Detroit, for $1,500,000. This mortgage is given in order to pay off the indebtedness already incurred by the road.

MAMARONECK, N. Y.—At a meeting of the village board of trustees a resolution was adopted directing the counsel to the board to take steps to have the franchise heretofore granted to the Tarrytown, White Plains & Mamaroneck trolley road revoked, on the ground that it had not lived up to its stipulations, and that the franchise was really forfeited, anyway.

WASHINGTON, D. C.—The Washington Traction & Electric Company has filed suit in equity against the Capital Railway Company and Frederick L. Hart, receiver. It is asked that all of the right, title, interest and estate of the Capital Railway Company in certain properties be sold by trustees, and the proceeds applied to the payment of judgments held by the complainant.

NEW HAVEN, CONN.—It has been stated by a New Haven Railroad officer that the New Haven Railroad Company would soon adopt the third-rail system on the Housatonic Railroad, between Great Barrington and Pittsfield, Mass. The step is to be taken at the urgent requests of wealthy summer residents of Lenox, who wish to head off an electric road between that place and Pittsfield.

LANCASTER, PA.—A charter has been granted the Lancaster, Mechanicsburg & New Holland Electric Railway Company. The road will start at the city limits and run to New Holland borough, a distance of 14 miles. The officers are William B. Given, Columbia, president; Samuel R. Shipley, Philadelphia; B. J. McGrann, J. W. B. Bausman and John D. Skiles, directors. The capital stock is $150,000.

JERSEY CITY, N. J.—It is reported that the Bergen County Traction Company, which has owned the trolley through Fort Lee, N. J., and the Riverside & Fort Lee Ferry Company have combined, and that both are being operated under the real management of the Third Avenue road in New York City, which, it is said, has secured a controlling interest in both the Fort Lee Trolley Company and the Fort Lee Ferry.

DETROIT, MICH.—Franchise rights for an electric railway between Port Huron and Bay City were sold at a meeting in Detroit, by William Wheat, of Tuscola, to E. M. Hopkins, of New York; N. S. Boynton, and associates. A company will be formed and construction work will begin early in the spring. The road will be 110 miles long, and will touch Lexington, Croswell, Sanilac Center and Caro, between Port Huron and Bay City.

DOYLESTOWN, PA.—Judge Yerkes has issued a decree for the sale of the Bucks County trolley road between Doylestown and Willow Grove. The sale will be at the Philadelphia Bourse, Wednesday, March 14. The road is now in the hands of a receiver, and it will, in all probability, be bought in by parties identified with the Union Traction Company, who have secured control of the stock. The indebtedness is $139,384.74.

MILWAUKEE, WIS.—The residents of Wauwatosa who refused to pay two fares to the Milwaukee Electric Railway & Light Company for riding from the corner of Thirty-sixth and Wells streets to the city of Wauwatosa, have been enjoined by the company from refusing to be ejected from the cars on their refusal to pay two fares, and have also been restrained from beginning suit against the company or its employees for their ejection.

NEWPORT NEWS, VA.—The Hampton Roads Railway & Electric Company has been organized to build a new electric railway between Newport News, Hampton and Old Point Comfort, and to supply electric power and electric light. The company has asked for a charter from the legislature and will be capitalized at not less than $50,000, nor more than $500,000. The chief incorporators are W. J. Nelms, of this city, and Alvah H. Martin, of Norfolk.

ORTONVILLE, MICH.—Lau and Winters were here about a month ago to secure a franchise through the township of Brandon for an electric railroad running from Oxford to Flint, which was granted. They want a bonus of $10,000 between here and Oxford. Committees were appointed and have about $3,000 already raised. Surveyors are at work on the road laying out the line. The road is to be completed by September next.

SOUTHINGTON, CONN.—The Connecticut Lighting & Power Company has purchased of the Southington & Plantsville Tramway Company all of the latter's property and assets. The meeting elected J. E. Sewell, H. W. Minor and G. E. Perry, of Waterbury, and E. H. Mather, of New Britain, directors. The new directors are all members of the Lighting & Power Company's directorate. Most of the stock has been held by Lighting & Power Company officials since last summer.

ALBANY, N. Y.—Articles of incorporation of the New York & Nassau County Railroad Company were filed on Jan. 9. The company, which capitalizes with $150,000, will operate its road by electricity. Its length is to be seven miles. The directors are Daniel Noble, Frederick Bowley, Daniel Callahan, Matthew J. Smith, William L. Woodill, of Long Island City; Patrick J. Mara, of Flushing; Joseph Bermel, Middle Village; Joseph Meyerose, Evergreens, and Edward J. McKeever, Brooklyn.

PLYMOUTH, MASS.—A charter has been granted to the Pembroke Street Railroad Company to operate a street railway through the towns of Pembroke and Kingston. The length of the road will be about seven miles. The capital stock is $20,000. W. O. Chapman is clerk and E. J. B. Huntoon, treasurer of the company, and these are directors: J. P. Morse, of Brockton; E. E. Hill, of Pembroke; W. O. Chapman, of Canton; Nathaniel Morton, of Pembroke; E. J. B. Huntoon, of Canton; L. H. Kieth, of Kingston, and W. W. Myrick, of Kingston.

BOSTON, MASS.—The railroad commission has approved the issue of $125,000 additional stock by the Wakefield & Stoneham Street Railway for the purchase of the Woburn & Reading, Mystic Valley, Salem & Wakefield, and Reading & Lowell street railways. The exchange of stock with the various companies is share for share. Approval has also been given for the issue of 1500 additional shares of stock at a market value of $150 and $840,000 debenture bonds by the Worcester Consolidated Street Railway to pay debt incurred in construction and equipment and to refund funded debt.

THE AUTOMOBILE.

THE CLEVELAND (OHIO) AUTOMOBILE CLUB has been incorporated by E. L. Strong, W. S. Root, Ralph R. Owen, Frank B. Stearn and A. Ingalls. The club is organized for social purposes.

AUTOMOBILES IN MEXICO.—The new incorporation of the Mexico City Electric Vehicle Company, which has a charter for an electric coach service and an electric omnibus system, has been received in the City of Mexico. Messrs. Whitney, Maloney and Widener, of New York and Philadelphia, are behind this enterprise. The concern's capital is ample and liberal. It is hoped to open the new service this spring.

THE UNION TRANSIT COMPANY, which was incorporated at Paterson, N. J., recently, has applied for a franchise for the use of certain streets in which to run stage lines. The new company will use automobiles, and will enter into competition with the Consolidated Traction Company, which controls all the electric railway lines in this section. In return for the franchise the company offers 2½ per cent. of the gross receipts for the first five years and 5 per cent. a year thereafter, payment to be secured by a bond. The capital stock of the company is $200,000, half of which is paid in. The principal incorporators are ex-State Senator Mallon, ex-Assemblyman Sturr, Park Commissioner Hall and George H. Longbottom, all of Paterson, and George White, of New York.

NEW COMPANIES.

THE NATIONAL ELECTRICAL APPLIANCES COMPANY, of New York, has been incorporated with a capital of $50,000. The company will make electrical and chemical engines.

THE MORGAN ELECTRICAL MACHINE COMPANY has been incorporated in Chicago by E. C. Morgan, D. B. Douglas and J. H. Barnard, all of Chicago. The capital stock is $25,000.

THE ELECTRICAL SURGICAL SUPPLY COMPANY has been incorporated in Hoboken, N. J. Capital, $100,000. Incorporators, W. E. Willmann, of Hoboken; C. B. Graf and H. Schlesinger, both of New York.

THE CONSOLIDATED RAILWAY ELECTRIC LIGHTING & EQUIPMENT COMPANY, of Jersey City, has been incorporated. Capital, $16,000,000. Incorporators, W. W. White, of New York; F. C. Rowley, of Brooklyn; W. C. Butler, of East Orange.

PERSONAL.

MR. C. O. BAKER, JR., who varied a trip on the Pacific Coast by a run across the sea to Honolulu, where he plumped fairly into the Eastern plague epidemic, has escaped all dangers and is due home in New York this week.

MR. F. B. RAE, the well known electrical engineer is visiting New York City in connection with important matters. He has of late done considerable work in the automobile field and an article on the subject of some of his work appeared in these pages last week.

MR. GEORGE TRACY ROGERS, of the Binghamton street railways and one of the most active spirits in the New York State Street Railway Association, has become a special partner in the Wall Street firm of Ellingwood & Cunningham, putting in $100,000 special capital.

MR. J. C. JONES.—The many friends of Mr. J. C. Jones, of the Harrison Safety Boiler Works, of Philadelphia, who has been confined to his home for the past month by serious illness, will be glad to learn that he is rapidly recovering and is now out of danger. He is expected to be at his office again before long.

REID—VAN KLEECK.—The marriage is announced, at the Collegiate Reformed Dutch Church in this city, of Mr. Thorburn Reid to Miss Bertha, daughter of Mr. and Mrs. William H. Van Kleeck. Mr. Reid is well known in the electrical engineering profession and has done considerable work in England, as well as in this, his native, country.

AHLM—CALLAGHAN.—The marriage is announced at St. John's Cathedral, Cleveland, Ohio, on Jan. 24, of Mr. C. E. F. Ahlm to Miss Katharine Theresa, daughter of Mr. and Mrs. J. Callaghan. Mr. Ahlm is a young electrical engineer of great ability, who has been engaged for some time in the traction and automobile field, and is now the electrical engineer of the Warren Electric & Specialty Company, of Warren, Ohio.

RUNYON—EAGLES.—On Jan. 17 Mr. Frederick Oscar Runyon, electrical engineer of the New York & New Jersey Telephone Company, Brooklyn, was married to Miss Hattie May, daughter of Mr. Eugene Eagles, of Newark. The wedding ceremony took place at 7 p. m. at the Roseville Avenue Presbyterian Church, in Newark. The happy pair departed on their honeymoon followed by the congratulations and good wishes of a host of friends.

Trade and Industrial Notes.

THE GOODRICH HARD RUBBER COMPANY, of Akron, Ohio, has reduced its capital from $300,000 to $100,000.

THE WARREN ELECTRIC & SPECIALTY COMPANY, Warren, Ohio, has issued a particularly attractive calendar for 1900. It contains a very handsome reproduction in colors.

THE MAYO & ROHRER COMPANY, who handle all kinds of second-hand electrical and steam machinery, have opened a New York office at 220 Broadway. Purchasers and sellers of machinery should write the above company for details, etc.

THE COLONIAL ELECTRIC COMPANY, Youngstown, Ohio, has issued a handsome 1900-calendar, in which the merits of "The" Colonial incandescent lamp are pointed out. The card contains a fine reproduction in colors of the well known painting, entitled "A Connoisseur."

THE ELECTRIC APPLIANCE COMPANY, Chicago, Western selling agent for the Sangamo Electric Company, Springfield, Ill., has issued a neat little pamphlet, describing and illustrating the Gutmann recording wattmeters for alternating current, manufactured by the company last named.

MESSRS. KINSBURY, SAMUEL & CO., electrical engineers and contractors, 204 East Lexington Street, Baltimore, Md., is sending out to its patrons and friends a very convenient pocket match safe. This firm is agent for the Eddy Electric Manufacturing Company's dynamos and motors.

THE EUREKA ELECTRIC COMPANY, Chicago, are sending out, gratis, a beautiful small lapel telephone emblem button. The design used is that adopted in several states by the independent telephone associations, and it makes a very handsome button. The Eureka Company will be pleased to mail one to any company in the field.

QUEEN & CO., Philadelphia, have just issued a pamphlet with reference to their facilities for making accurate measurements of the candle-power and efficiency of incandescent lamps. They mention both the standard of light and the electrical measuring instruments employed, and also give an illustration and description of their new portable photometer.

THE OSBURN ELECTRIC MANUFACTURING COMPANY, 294 and 296 Dearborn Street, Chicago, report a largely increased trade during the past year. This company is now operated and controlled by Mr. Louis Jones, who was formerly its treasurer. Attention is called to their quick soldering paste, which is indorsed by large manufacturers for use on any class of electrical work.

THE CHASE-SHAWMUT COMPANY, Boston, Mass., has just issued from its switchboard department bulletin No. 8, in which are briefly described the various classes of switchboards manufactured by it. The front page has a large illustration of the switchboard for the Metropolitan Water Board, Chestnut Hill, Mass., and the last page contains an illustration of a Cushing theatre switchboard.

"NEW YORK PRESS" has sent us a copy of its excellent quarterly almanac, edition for 1900—a solid volume of 448 pages, chock full of facts, data, statistics, history, geography, lists, items of information, maps, etc. A great deal of this work comes, we understand, from the able hand of Mr. Julius Muller, of the editorial staff, who is to be heartily congratulated upon the great utility of the publication.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has issued a series of bulletins, Nos. 3007, 3009, 3011, 3013 and 3014, devoted respectively to theatre switchboards, very small power alternating current induction motors for single-phase currents, switchboard material, isolated plant switchboards, and Diamond E knife switches. Discount sheets accompany bulletins 3009 and 3011 and a sheet of net prices comes with bulletin 3014.

THE WARREN MANUFACTURING COMPANY, of Chicago, manufacturers of Warren's liquid pulley cover, have just moved into very pleasant offices on the tenth floor of the new Cable Building, at the corner of Jackson Boulevard and Wabash Avenue. They report business very brisk. They have recently issued some unique literature describing Warren's liquid pulley cover, and giving in detail the reasons for the great success experienced in its promotion among electricians. Their duplicate order business is of such a size that they regard it as a guarantee of the merit of the article.

MESSRS. PARSELL & WEED, 129 West Thirty-first Street, New York, have issued a pamphlet in which they give an outline of the character of their business, which is that of electrical, experimental and fine tool work. Their shop is equipped with the most modern machinery, which, added to their experience in this field, enables them to successfully compete for trade. They are prepared to make anything in the mechanical line, from a single piece to a complete working model. Their electrical testing and designing outfit is first class and enables them to make models after the specifications of their customers.

TRAIN LIGHTING FROM THE CAR AXLE.—The Electric Axle Light & Power Company, 100 Broadway, New York, has just brought out a very artistic catalogue of its system of train electric lighting and car refrigeration from the axle. The system is concisely described, and its applications to railway cars is illustrated in an artistic manner. The various elements of the system are also shown. The subject of train lighting by electricity is one that has occupied the attention of inventors and railroad managers for many years, and those concerned will, no doubt, be deeply interested in what this pamphlet contains.

NATIONAL CALENDAR.—Mr. William Roche, manufacturer of the "New Standard" dry battery has gotten up a handsome calendar for 1900. It contains a sheet for each month. On each sheet, besides the monthly calendar, is a fine, large picture of one of the United States government buildings and an illustration of an application of the "New Standard" battery. Each sheet is printed in three tints and altogether the calendar makes one of the most attractive that we have seen this year. The fact that this battery is used very extensively in various departments of the government, the title of the calendar is quite appropriate. On the first sheet "Old Glory," in true colors, is emblazoned.

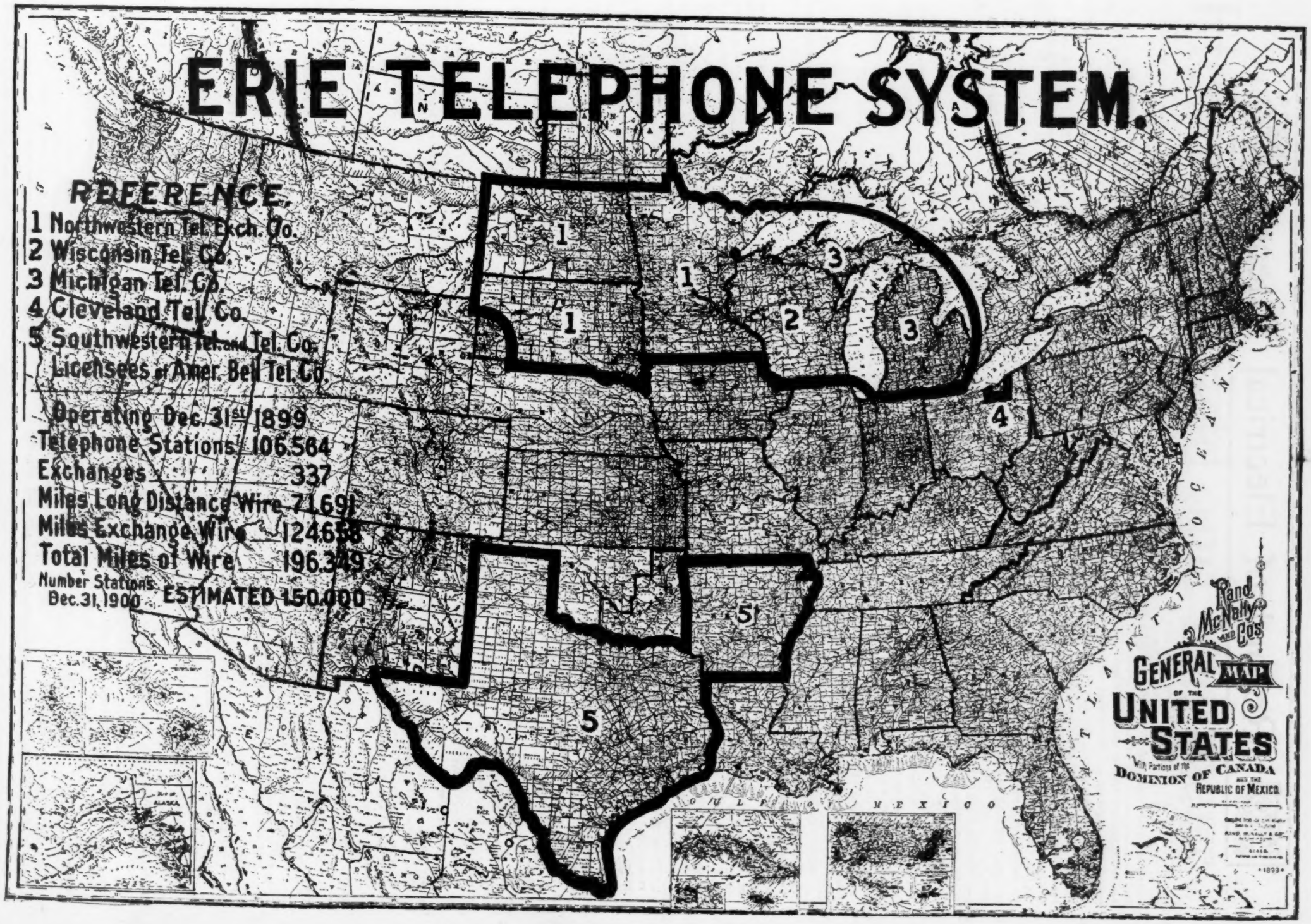
THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., have very largely increased their manufacturing capacity since last season, and will make every effort to be in a position to make prompt deliveries of desk and ceiling fans during the entire fan motor season now opening. The 1900 models of Emerson desk and ceiling fans will be considerably improved over the models placed on the market by them in the past. A large number of orders have already been booked for delivery in the United States and for export.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, report that the demand for the improved Warren alternator and the Eddy direct current belted and direct connected apparatus, for which they are exclusive territory agents, has been unprecedented. They state that the business prospects for the coming year are even brighter than they were at the beginning of last year. They have at the head of their engineering and contracting department one of the best electrical engineers in the country, and are always glad to answer inquiries of any kind concerning central station and isolated plant troubles, and solicit the opportunity of drawing up specifications and estimates on anything electrical. They have a large number of bulletins and data which they furnish on application.

FEDERAL SALT DRY BATTERY.—The Federal Battery Company, of New York, which manufactures Federal Salt and Federalite, announce that it is enlarging its plant at Bound Brook, N. J. The Federal Battery Company has perfected a dry cell, the name of which will be the "Federal Salt Non-Polarizing Dry Battery." The success the company has had with Federal Salt and Federalite leads it to believe that the new cell will have a large sale, as the demand for a perfectly reliable dry cell is increasing, and battery users are willing to pay a good price for such a cell. It intends to make a specialty of its miniature batteries and claims they will not deteriorate on the shelf, and will stand closed circuit work for a considerable time and then recuperate quickly. The company is making arrangements to do a large foreign, as well as domestic business.

THE WILLARD AUTOMOBILE STORAGE BATTERY.—Messrs. Sipe & Sigler, Cleveland, Ohio, regard as one of the important steps of progress in the interesting and rapidly increasing electric automobile industry the fact that the Willard automobile storage battery may be charged in 45 minutes. It is this firm's purpose to make a specialty of maintaining for a period of years, at a specified sum per year, all Willard automobile batteries, whatever may be the make of the carriage in which they are used. This contract of maintenance will be made direct with the owner of the carriage. It is the firm's belief that these two features will be of enormous advantage to the manufacturer of the carriage, and that no objection can be found or urged against the electric automobile. A catalogue recently issued by this firm gives full details regarding these departures, and much other valuable information on the general subject.

TROLLEY COMPETITION.—A paragraph is going the rounds of the press stating that "the new and vigorous management of the New York Central has decided to fight the trolley at every point offering competition along its line." That is rather ridiculous when you come to think it over. What occasion has the old and reliable New York Central got to fight the trolley for anyway? Take for instance its Buffalo and Niagara Falls branch. What in the name of common sense has it got to fear from the trolley in the long run? Doesn't it meet the prices of the trolley and then doesn't it beat the trolley by an hour or more in the trip between the two places? Then hasn't the New York Central a private right of way which precludes, to a large degree, the probability of delays to its trains through killing and maiming people in vehicles en route? Then again the New York Central has the great advantage of operating roomy and comfortable cars for the accommodation of the traveling public. Fight the trolleys indeed? Why even the trolley officials themselves use the New York Central between here and Buffalo. Catch any of them going to business between the leading cities on the Niagara frontier in their own cars. Rats!—From the Niagara Falls *Daily Cataract*.


ERIE TELEPHONE SYSTEM.
REFERENCE.
1 Northwestern Tel. Exch. Co.
2 Wisconsin Tel. Co.
3 Michigan Tel. Co.
4 Cleveland Tel. Co.
5 Southwestern Tel. and Tel. Co.
Licensees of Amer. Bell Tel. Co.
Operating Dec. 31st 1899
Telephone Stations 106,564
Exchanges 337
Miles Long Distance Wire 71,691
Miles Exchange Wire 124,658
Total Miles of Wire 196,349
Number Stations Dec. 31, 1900 ESTIMATED 150,000
1
2
3
4
5
Rand McNally and Co's
GENERAL MAP
OF THE
UNITED STATES
With Portions of the
DOMINION OF CANADA
AND THE
REPUBLIC OF MEXICO.
ATLANTIC OCEAN
GULF OF MEXICO

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED JAN. 16, 1900.

[In Charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

641,257. ELECTRICAL CONTROLLING DEVICE; H. P. Ball, New York, N. Y. App. filed Oct. 24, 1896. This device is particularly adapted for controlling theatre lights and is arranged so that individual lamps or groups may be controlled at will or the entire number of lamps affected. A number of handles are pivoted upon a common shaft and locking devices are provided for engaging and disengaging them by their own rotation.

641,264. CONTACT BOX FOR ELECTRIC TRAMWAYS; E. Bonnet, J. Paufique and G. Liniere, of Lyons, France. App. filed June 16, 1899. The contact box connects with a plug in the surface of the roadway with which contact is made by the car. The invention is designed to hermetically seal the box. A plurality of mercury seals are used and the connection between the terminal of the cable and the active terminal is through a mercury cup.

641,275. MOTORMAN'S RECORDER; J. R. Cravath, Chicago, Ill. App. filed April 1, 1899. (See Current News and Notes.)

641,290. PRESSURE-REGULATING APPARATUS FOR MAINS; J. S. Highfield, St. Helens, England. App. filed July 21, 1899. (See Current News and Notes.)

641,306. ELECTRIC WATER HEATER; A. W. Lawton, New York, N. Y. App. filed April 6, 1899. Pipes through which water flows are surrounded by a resisting conductor by which the pipe is heated and the heat communicated to the water.

641,322. METHOD OF REGULATING ELECTRIC CIRCUITS; M. Pfatischer, Philadelphia, Pa. App. filed July 7, 1899. (See Current News and Notes.)

641,335. GALVANIC BANDAGE; P. L. Schmidt, of Worms, Germany. App. filed April 11, 1899. The materials of a dry cell are put together in the form of a bandage. Metallic studs connecting with the battery elements are exposed on the surface of the bandage, so that the circuit will be completed through the body of the person wearing the bandage.

641,360. ELECTRIC AMALGAMATOR; L. H. Barricks, San Francisco, Cal. App. filed Oct. 2, 1899. (See Current News and Notes.)

641,371. TROLLEY ARRESTER; W. E. Carlyle, New York, N. Y. App. filed May 27, 1899. The trolley cord is connected to a spring drum which is held by a latch controlled by a magnet in the trolley circuit. When the trolley leaves the wire the drum is released, the cord wound up and the trolley pole pulled downward.

641,375. TELEPHONE SWITCHBOARD; F. B. Cook, Chicago, Ill. App. filed Feb. 8, 1898.

641,374. COMBINED TERMINAL HEAD AND JUNCTION BOX; F. B. Cook, Chicago, Ill. App. filed Feb. 26, 1898. This device is intended primarily to be mounted on poles, and, besides having suitable connecting devices for the wires, it is covered to protect it from the weather.

641,383. TROLLEY CATCHER; H. W. Graham, Louisville, Ky. App. filed Nov. 15, 1899. The trolley cord passes under the lid of a box to a spring drum inside thereof. When the trolley leaves the wire and rises the box lid is opened and the drum thereby unlocks to permit the spring to wind up the cord and lower the trolley.

641,400. CONNECTION COUNTER FOR TELEPHONE LINES; F. R. McBerty, Downer's Grove, Ill. App. filed Jan. 9, 1897.

641,412. SYSTEM OF ELECTRIC CIRCUITS AND BRAKES FOR VEHICLES; E. A. Sperry, of Cleveland, Ohio. App. filed Sept. 16, 1899. This is a system of control for a vehicle which carries separate generating units, motor or motors, electric brakes, resistances, meters, etc.

641,425. MICROPHONE; J. O. Zwarg, Freiburg, Germany. App. filed Sept. 21, 1897.

641,452. MEANS FOR CONTROLLING ELECTRIC MOTORS; R. M. Hunter, Phila., Pa. App. filed Jan. 16, 1894. (See Current News and Notes.)

641,453. METHOD OF CONTROLLING ELECTRIC MOTORS; R. M. Hunter, Philadelphia, Pa. App. filed Nov. 9, 1899. (See Current News and Notes.)

641,463. PORTABLE ELECTRIC LAMP; H. J. Muller, of New York, N. Y. App. filed April 27, 1899. In the same structure with the lamp is a battery and an automatic switch. When the device is lifted from a table or other support the switch closes and the lamp lights; when it is again placed on its support the switch opens and the lamp goes out.

641,484. APPARATUS FOR MEASURING VELOCITY OF SOUND WAVES; W. Wolff, Charlottenburg, Germany. App. filed Nov. 26, 1898. (See Current News and Notes.)

641,538. ELECTROMAGNETIC APPARATUS; Francisco de Borja Pavon, of Caibarien, Cuba. App. filed Nov. 4, 1899. Relates to a type of dynamo field, consisting of a series of poles and windings one within the other, the windings all being excited by the same current. The stated object is to concentrate the magnetism.

641,545. BUTTING AND POINTING MACHINE; C. T. Richmond and M. M. Zellers, Cleveland, Ohio. App. filed July 10, 1899. This machine is used to finish the ends of carbon pencils and includes an endless chain in which the pencils are seated and sent through the machine wherein the ends of the carbons are operated upon by various devices.

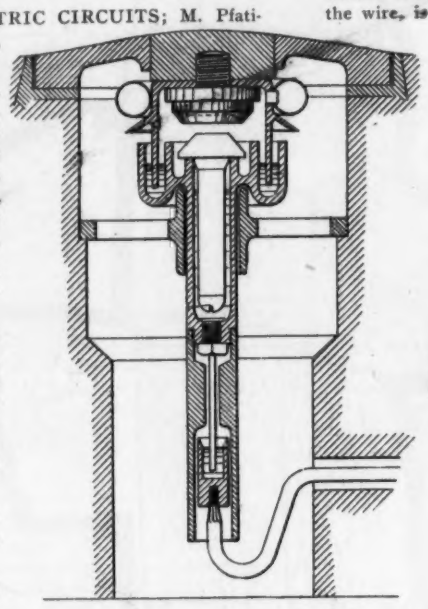
641,569. TELEPHONE APPARATUS; D. H. Wilson, Chicago, Ill. App. filed Jan. 29, 1898.

641,570. TELEPHONE; D. H. Wilson, Chicago, Ill. App. filed Jan. 20, 1899.

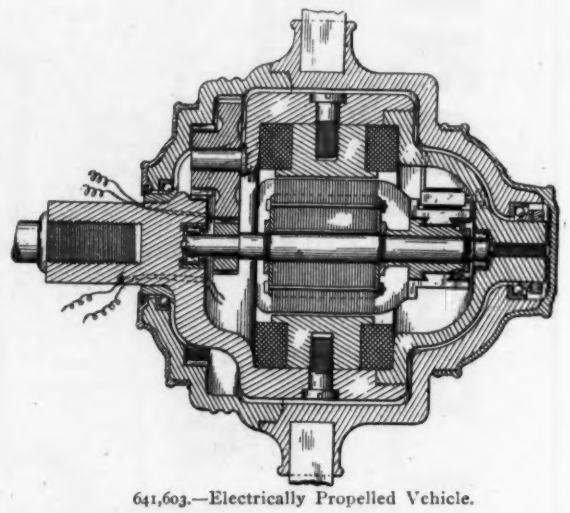
641,603. ELECTRICALLY PROPELLED VEHICLE; F. J. Newman and J. Ledwinka, Chicago, Ill. App. filed Sept. 1, 1899. A motor is placed inside of the hub of the wheel, the armature being geared to the hub.

641,607. ELECTRICITY METER; P. Rissler and H. Bauer, Freudenstadt, Germany. App. filed Nov. 18, 1899. (See Current News and Notes.)

641,663. TELEPHONE; A. A. Low, New York, N. Y. App. filed Feb. 5, 1898.



641,264.—Contact Box for Electric Tramways.



641,603.—Electrically Propelled Vehicle.

GERMAN PATENTS, ISSUED JAN. 4, 1900.

[In Charge of Dr. Ralph Julian Sachers, 120 Liberty Street, New York City.]

105,975. INSULATING MACHINE; Ettore Albasini, Turin. App. filed April 21, 1898. A rotating cylinder is provided with a central tapered hole, at the narrow end of which there are a number of conical cylinders, rotating around their own axles. Moist cotton, loosely and spirally wound around the wire, is thus evenly distributed and sufficiently compressed.

105,977. MAGNETIC CONDUCTOR; Albert Lotz, Ragaz. App. filed July 12, 1898. Tin plates, placed one upon the other, and forming a magnetic conductor, are compressed at several places in the usual manner, and at other places spread out, so that open spaces are formed, whereby the cooling surface is considerably enlarged.

105,979. ELECTRIC METER; Thomas Alva Edison, Orange. App. filed Aug. 30, 1898. This meter belongs to that class in which a scale beam is made to oscillate on account of electrolytic action, whereby the current is reversed. The beam in this apparatus serves as the anchor of a clockwork accomplishing the registration. By each release of the clockwork a switch-lever is thrown from one contact piece unto the other, and thereby not only is the current reversed in the cells, but the latter are also in alternation connected to one or the other half of a resistance.

105,980. ELECTRIC METER; Harry Phillips Davids, Pittsburg, and Frank Conrod, Wilkinsburg. App. filed Sept. 27, 1898. A copper disk is actuated upon by a rotating magnetic field, which field is produced by an electromagnet having a laminated iron core, an air space, a primary coil, and a secondary closed circuit coil. A spiral spring opposes the action of the magnetic field. In order to make the deviation of the disk proportional to the current strength, the circumference is made in form of a spiral line.

106,025. GALVANIC CELL; Wilde & Co., Hamburg. App. filed Dec. 14, 1897. A carbon electrode filled with depolarizing material and closed with an insulating layer rests upon a layer of sulphuric acid salts with or without an addition of sodium chlorate, which layer covers the bottom of the battery jar. A porous diaphragm upon which rests the zinc electrode, separates the bottom layer from the electrolyte surrounding the electrodes. Such cells give an e. m. f. of two volts for a considerable length of time.

106,450. ORE SEPARATORS; Bergwerks-Actien-Verein, Mechernick. App. filed July 17, 1898. Two cylindrical poles are located parallel to each other and separated by a small space. One is covered with a non-magnetic mantle, and when both cylinders are rotated, one only can attract the metal particles of the granulated ore so as to separate them from the other material.